

TM 11-2201

WAR DEPARTMENT TECHNICAL MANUAL

REPERFORATOR TELETYPEWRITER SETS TC-16 AND TC-17

WAR DEPARTMENT • MAY 1947

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TM 11-2201

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REPERFORATOR
TELETYPEWRITER
SETS
TC-16 AND TC-17



WAR DEPARTMENT

• MAY 1947

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Washington 25, D. C., 23 May 1947

TM 11-2201, Reperforator Teletypewriter Sets TC-16 and TC-17, is published for the information and guidance of all concerned.

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For explanation of distribution formula, see TM 38-405.

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DESTRUCTION NOTICE

WHY—To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN—When ordered by your commander.

- HOW—**
1. Smash—Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.
 2. Cut—Use axes, handaxes, machetes.
 3. Burn—Use gasoline, kerosene, oil, flame throwers, incendiary grenades.
 4. Explosives—Use firearms, grenades, TNT.
 5. Disposal—Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT

- WHAT—**
1. Smash—Reperforator, including base, typing mechanism, motor and keyboard; transmitter distributor, including motor, distributor, transmitting head; jack box, line unit, rectifier chests and carrying case, and all other parts.
 2. Cut—All wiring.
 3. Burn—Chests, carrying case, manuals, diagrams, and all smashed parts.
 4. Bend—All metal parts.
 5. Bury or scatter—Any and all damaged parts which cannot be burned readily.

DESTROY EVERYTHING

SAFETY NOTICE

Severe shock may result from contact with current-carrying parts of this equipment. Be sure that the power is off before changing voltage taps and making adjustments within the equipment. Handle line wires carefully.

CHAPTER 1

INTRODUCTION

Section I. DESCRIPTION OF REPERFORATOR TELETYPE- WRITER SETS TC-16 and TC-17

1. General

a. Reperforator Teletypewriter Sets TC-16 (fig. 1) and TC-17 provide complete portable sending and receiving teletypewriter stations for field or station use. These sets consist essentially of a typing reperforator, a keyboard, and a transmitter distributor adapted for use on 60-milli-ampere (ma) neutral type networks or for point-to-point communication. Provision is made for operating either of the sets in conjunction with Telegraph Printer Set (Teletypewriter) EE-97 or EE-98, or Teletypewriter Sets EE-97-A, EE-98-A, or EE-102. They can also be used in the standard manner with Telegraph Central Office Set TC-3.

b. Except for differences in the reperforator keyboards and type symbols (fig. 8) and end-of-line mechanism adjustments for the reperforators, Reperforator Teletypewriter Sets TC-16 and TC-17 are alike. These differences are explained in paragraph 5.

c. Major components of the sets are interchangeable. Their approximate weights and dimensions are listed in paragraph 2.

d. Reperforator Teletypewriter Set TC-16 uses Reperforator Transmitter TG-26-A (fig. 2), which has a standard communication keyboard and typebar symbols. Reperforator Teletypewriter Set TC-17 uses Reperforator Transmitter TG-27-A which has a weather communication keyboard and typebar symbols. The two reperforators print different characters when the platen of the reperforator is in the figures-printing position (par. 5).

e. Throughout this manual references are made to related Technical Manuals which include planning information, installation procedures, and operating features of other teletypewriter equipment. Listed below are the Technical Manuals with which this manual will normally be used and in which reference may be made to the reperforator teletypewriter sets:

TM 11-352, Printer TG-7-A and Teletypewriter TG-7-B and TG-37-B.

TM 11-354, Telegraph Printer Sets (Teletypewriter) EE-97 and EE-98, Teletypewriter Sets EE-97-A, EE-98-A, and EE-102.

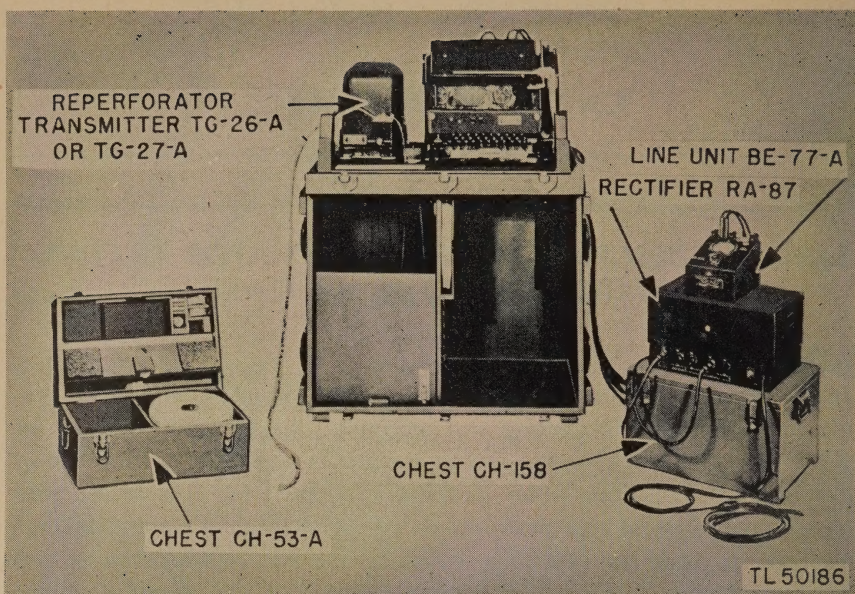


Figure 1. Reperforator Teletypewriter Set TC-16.

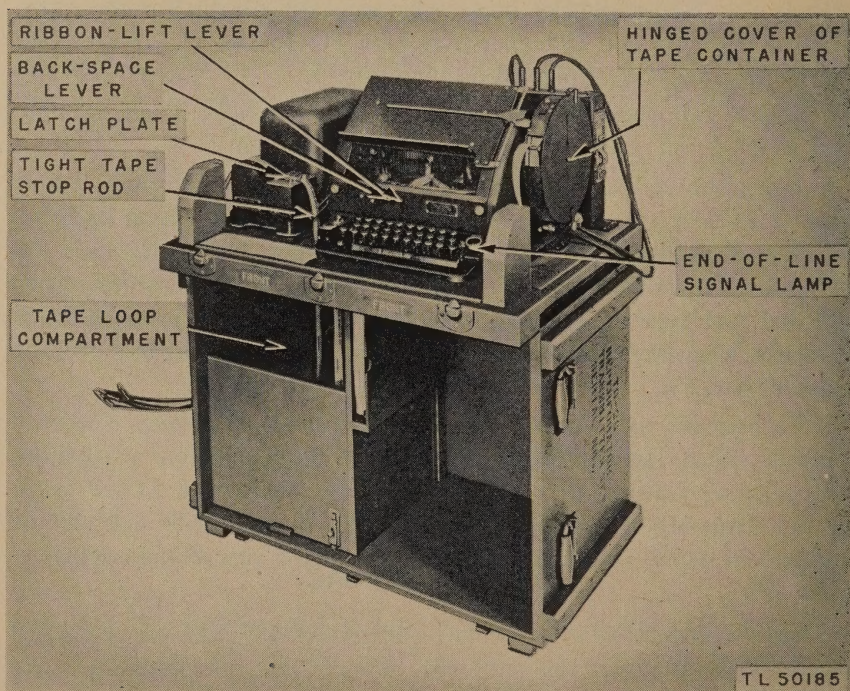


Figure 2. Reperforator Transmitter TG-26-A, over-all view.

TM 11-358, Telegraph Central Office Set and Switchboard BD-100 (being revised).

TM 11-359, Line Units BE-77, -A, and -B.

TM-11-2004, Repeater Set TC-18 (Terminal, Telegraph).

TM-11-2203, Teletypewriter Sets AN/TGC-1.

TM 11-2222, Transmitter Distributors (Teletype Model 14).

TM 11-2223, Typing and Nontyping Reperforators (Teletype Model 14) (when published).

f. Official Signal Corps nomenclature followed by (*) is used throughout this manual to indicate any item of equipment, regardless of its model or procurement, covered by this manual.

2. Table of Components

Listed below are components of Reperforator Teletypewriter Sets TC-16 and TC-17. The data given are for the equipment unpacked and ready for use. See paragraph 3 for weights, dimensions, and volume of the shipping containers used for packing the equipment for export shipment.

a. REPERFORATOR TELETYPEWRITER SET TC-16.

Quantity	Component	Weight (lb)	Width (in.)	Length (in.)	Height (in.)
1	Reperforator Transmitter TG-26-A, complete in carrying case.	225	19	33	38
1	Rectifier RA-87, complete in chest.	57	12½	18½	10½
1	Line Unit BE-77-A, with group of accessories and spare parts, complete in case.	31	6	8¼	6¾
2	Ground Rods MX-148/G.	10 ea		72 ea	

Note. This list is for general information only. See appropriate publications for information pertaining to requisition of spare parts.

b. REPERFORATOR TELETYPEWRITER SET TC-17. Major components of this set are the same as those listed for Reperforator Teletypewriter Set TC-16, except that Reperforator Transmitter TG-27-A is substituted for Reperforator Transmitter TG-26-A.

3. Packaging Data for Export Shipment

Listed below are the weights, dimensions, volume, and contents of each oversea shipping container containing units of Reperforator Teletypewriter Set TC-16 or TC-17.

Contents of package	Weight (lb)	Width (in.)	Length (in.)	Height (in.)	Volume (cu ft)
Reperforator Transmitter TG-26-A or TG-27-A.	290...	33...	41...	27...	21
Rectifier RA-87	70...	18...	24...	16...	4
Line Unit BE-77-A	55...	17...	25...	16...	4
Two Ground Rods MX-148/G...	20...	4...	72 ea.		2.5

4. Description of Major Components

The reperforator transmitters included in Reperforator Teletypewriter Sets TC-16 and TC-17 consist essentially of a modified Teletype Corp model 14 typing reperforator with a keyboard and modified Teletype Corp model 14 transmitter distributor. Both units are shock-mounted on a common wooden base and are protected in transportation by a wooden cover. When the units are prepared for operation, this wooden cover serves as a table (figs. 2 and 5).

a. REPERFORATOR TRANSMITTER TG-26-A. This component of Reperforator Teletypewriter Set TC-16 perforates and types messages on tape from the keyboard locally or from line signals and sends signals from tape run through the transmitter. The typing reperforator and keyboard and transmitter are mounted on a common wood base which is also used as the base of the case in which the unit is carried. The reperforator is equipped with a standard communication keyboard and typebar symbols. When used with a keyboard transmitter in a local circuit, it also serves the purpose of a keyboard tape perforator. Receiving units of this kind are particularly adaptable for use at message distribution centers because the perforated tape may be used to retransmit the message to one or more stations by means of another unit known as the transmitter distributor. Thus the necessity for manual transmission by direct keyboard or manual preparation of perforated tape is eliminated. The typewritten characters on the tape facilitate identification and distribution of the message tape at a message center. Figure 3 illustrates the principle of message handling with the typing reperforator and transmitter distributor. A jack box (fig. 4) mounted on the base provides a means of making connections to 60-ma neutral circuits. The reperforator is furnished with a pulling magnet and no line relay. The motors are series a-c governed type adjustable for 368 or 404 operations per minute (opm). Operation is controlled by the motor switch. Figure 4 shows a rear view of the reperforator transmitter, indicating location of the jack box and power selector switch, and figure 5 shows Reperforator Transmitter TG-26-A ready for shipment. The typing reperforator uses standard perforator tape $\frac{11}{16}$ inch wide. Typing and perforating occur simultaneously, but, because the platen is to the right of the perforator die block, characters are typed at the right of their respective perforations. The signal code used to operate the typing reperforator is known as the five unit code. It consists of 32 arrange-

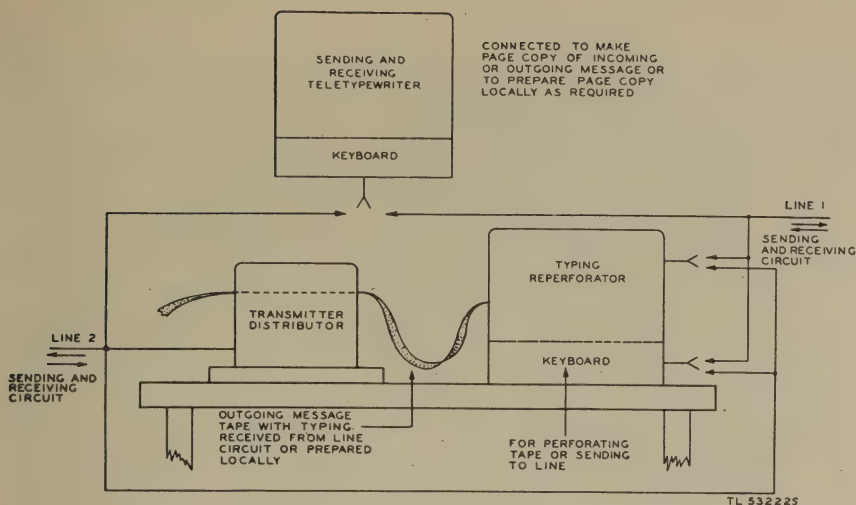


Figure 3. Message handling with typing reperforator and transmitter distributor.

ments of current and no-current intervals of code combinations, each consisting of five parts. To print a certain character the code combination assigned to that character must be received.

b. REPERFORATOR TRANSMITTER TG-27-A. This component of Reperforator Teletypewriter Set TC-17 is the same as Reperforator Transmitter TG-26-A, except that it is equipped with a reperforator keyboard and typebar symbols for communication and for sending and receiving weather information, and the adjustment for end-of-line indicator varies as described in paragraph 5.

c. LINE UNIT BE-77-A. This component of Reperforator Teletypewriter Sets TC-16 and TC-17 is an electrical device especially designed for use as part of army tactical (field) teletypewriter sets which transmit and receive direct-current (d-c) neutral line signals. The line unit (fig. 6) makes the necessary connections between the d-c power source, a wire line circuit, and teletypewriter equipment; repeats teletypewriter signals transmitted to and received from the line into the teletypewriter receiving mechanism; measures and adjusts line current; adjusts quality (bias) of the received signals, and measures voltage of the d-c power source and bias in line signals. TM 11-359 covers Line Unit BE-77-A in detail.

d. RECTIFIERS. When a source of alternating-current (a-c) power is available, a rectifier is required to convert the a-c power to 115-volt direct current for operation of the reperforator transmitter signal circuits, local circuits, and line unit circuits. Rectifier RA-87 (fig. 7), component of these reperforator teletypewriter sets, is packed in Chest CH-158 and is described in detail in TM 11-957. The rectifier operates on 50- to 60-cycle a-c and provides 0.4 ampere of 115-volt d-c for the

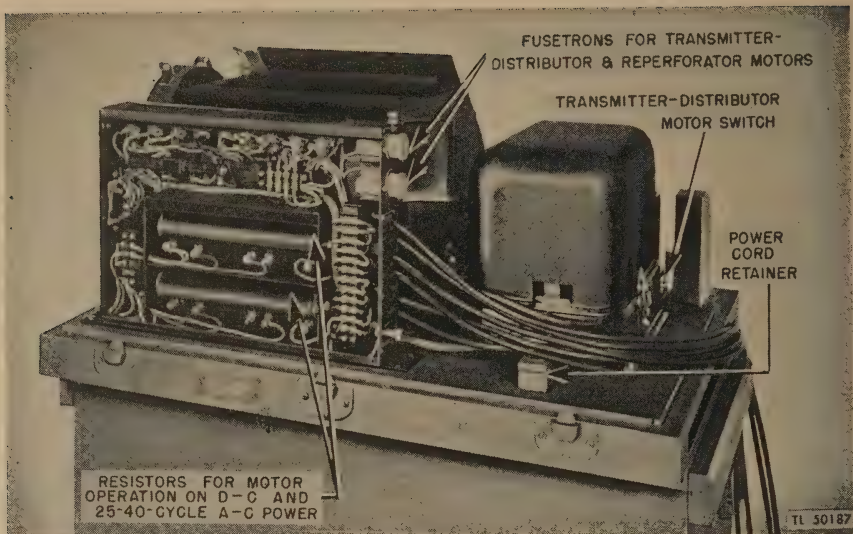


Figure 4. Reperforator Transmitter TG-26-A, rear view.



Figure 5. Reperforator Transmitter TG-26-A, ready for shipment.

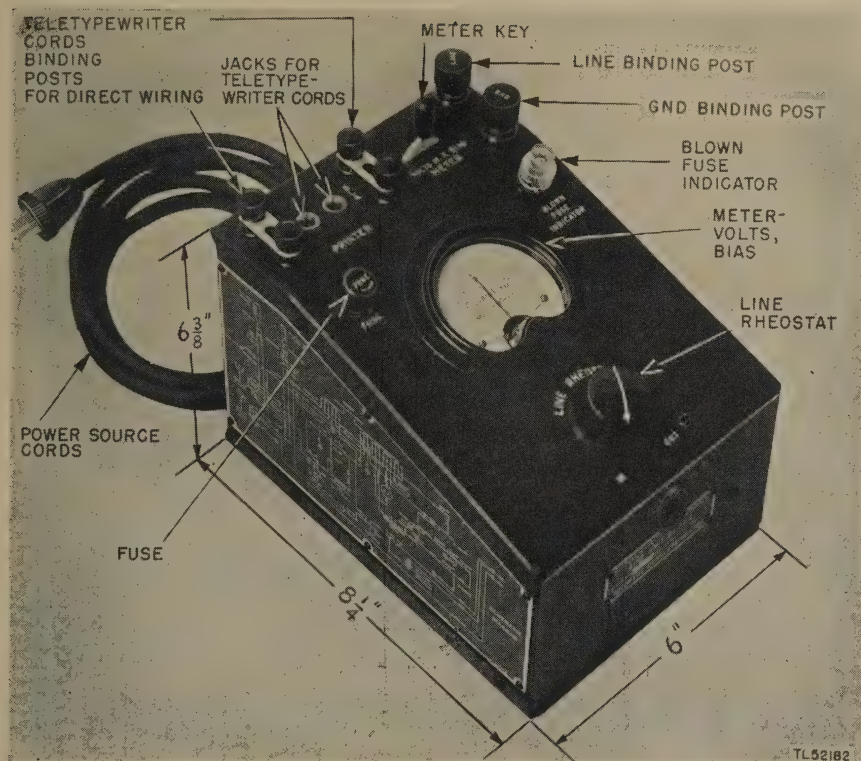


Figure 6. Line Unit BE-77-A.

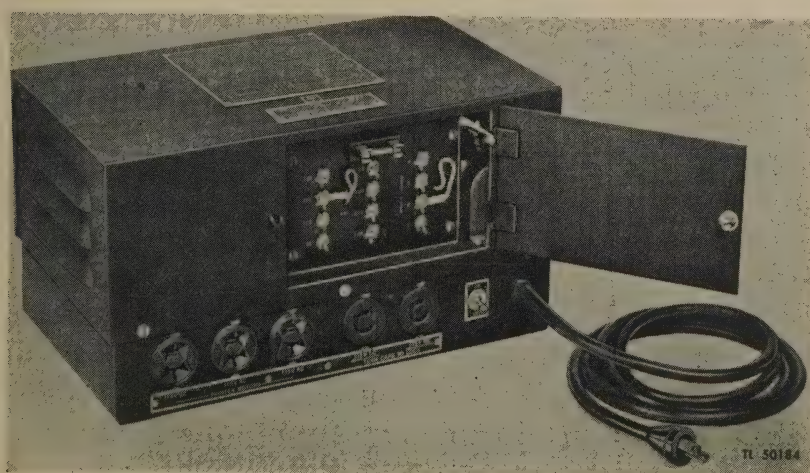
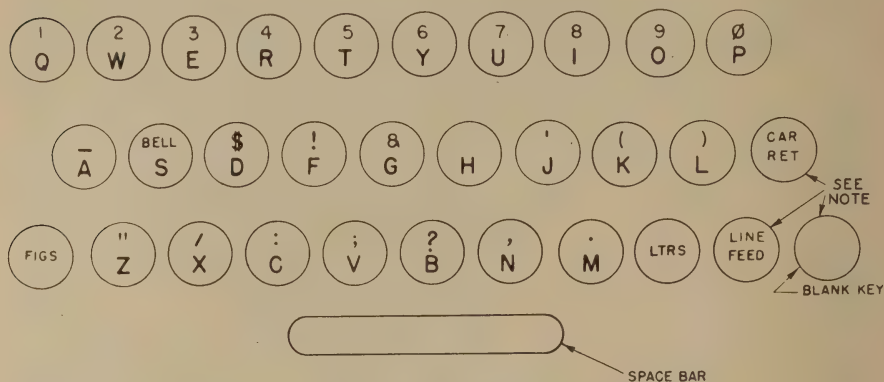


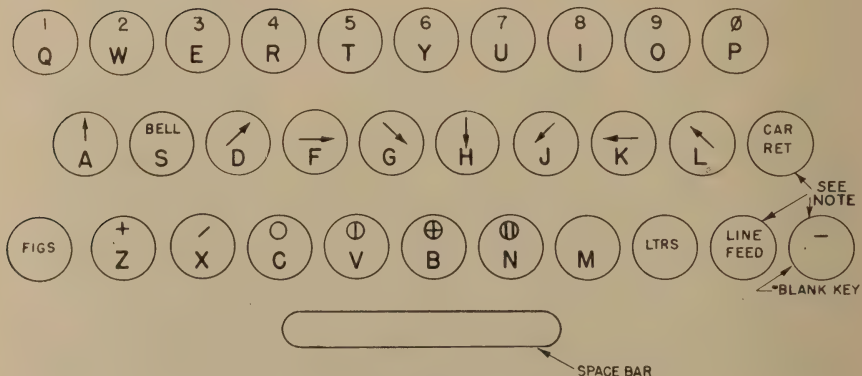
Figure 7. Rectifier RA-87, door open.

signal and line circuits. Taps on the input circuit are adjustable for a-c supply voltages of approximately 95, 105, 115, 125, 190, 210, 230, and 250 volts. The rectifier also provides three outlets for up to 500 watts of 115-volt a-c power for operation of the reperforator transmitter motors. The a-c voltage at these outlets is adjusted by means of 95-, 105-, 115-, and 125-volt taps on the transformer. The d-c output is adjustable over a range of about 10 volts in three steps.

Note. In localities where only 25- to 40-cycle a-c current is available, Rectifier RA-89 may be used in place of Rectifier RA-87. Rectifier RA-89 is similar to



TG-26- A COMMUNICATION KEYBOARD



TG-27- A WEATHER KEYBOARD

NOTE: THESE KEYS PRINT THE FOLLOW SYMBOLS:

CAR RET	<	} IN BOTH UPPER AND LOWER CASE
LINE FEED	≡	
BLANK KEY	{	{ (LOWER CASE) - (UPPER CASE)
	{	

TL50176

Figure 8. Keyboards of Reperforator Transmitters TG-26-A and TG-27-A.

Rectifier RA-87 in output, input voltages, and adjustment characteristics but operates on 25- to 70-cycle a-c. It is larger and heavier than Rectifier RA-87 and is packed in Chest CH-159.

5. Differences in Models

a. Figure 8 illustrates the differences in keyboards of Reperforator Transmitters TG-26-A and TG-27-A. The reperforator keyboard and type pallets of Reperforator Transmitter TG-26-A have standard communication symbols. Reperforator Transmitter TG-27-A has a reperforator keyboard and typebar pallets that have weather symbols. The 14 weather symbols indicated on the key tops are printed when the platen is in the figures position, in place of the communication symbols shown in the key tops.

b. The reperforator end-of-the-line indicator signal lamp on Reperforator Transmitter TG-26-A is adjusted to operate when approximately 65 characters have been perforated, indicating that associated page teletypewriters are nearing the end of a line of type. The end-of-the-line indicator on the reperforator of Reperforator Transmitter TG-27-A is adjusted to operate when approximately 69 characters have been perforated. Figure 2 shows the end-of-the-line indicator on the reperforator transmitters.

Section II. APPLICATION OF EQUIPMENT

6. Basic Teletypewriter System

Two Reperforator Teletypewriter Sets TC-16 or TC-17 connected by a direct wire line can make up a basic teletypewriter system in one of its simplest forms. A station installation may consist of only the components forming one or the other of the reperforator teletypewriter sets or may also include other teletypewriters. Likewise an installation may involve one or two circuits with operation on either a point-to-point or network basis. Wire facilities used to connect the teletypewriter sets may be any type of field wire, cable, or open wire that meets requirements for wire construction in a particular location. TM 11-468 gives information on the average lengths of wire that provide satisfactory teletypewriter service. Figure 9 is a block diagram showing a simple point-to-point set-up involving reperforator teletypewriter sets and some associated equipment.

7. Use With Other Teletypewriter Systems

When each reperforator teletypewriter set is connected to a telegraph central office set, a switching arrangement is provided that will permit each of the teletypewriter sets or stations to be connected to any one or several other teletypewriter stations on any of several circuits controlled

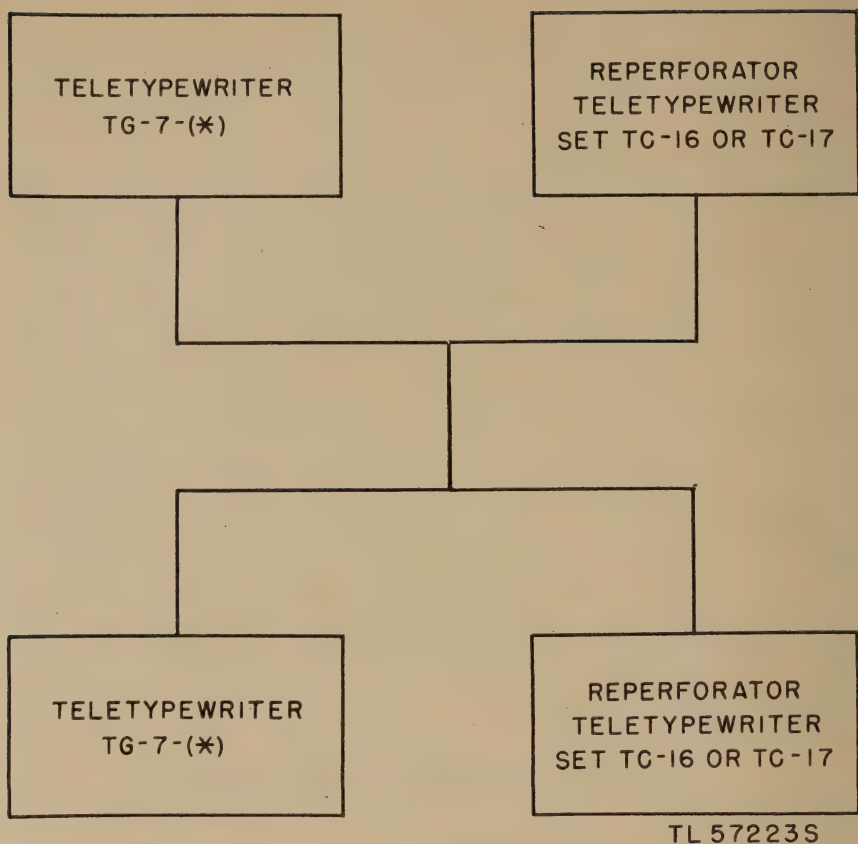
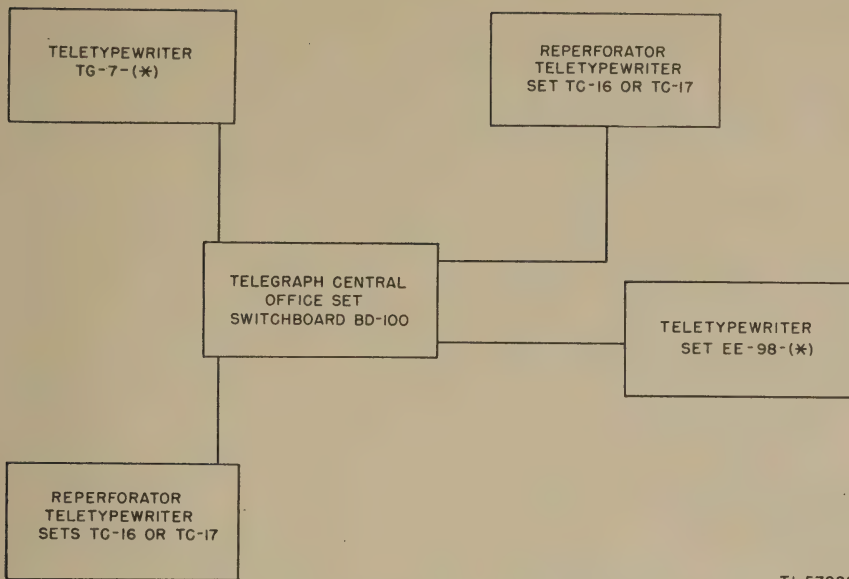


Figure 9. Reperforator teletypewriter sets in simple point-to-point set-up.

through the switchboard. By such an arrangement it is also possible to connect several teletypewriter stations through the switchboard for conference. Figure 10 is a block diagram showing various teletypewriter equipments, including Reperforator Teletypewriter Sets TC-16 and TC-17 connected by means of a telegraph switchboard.

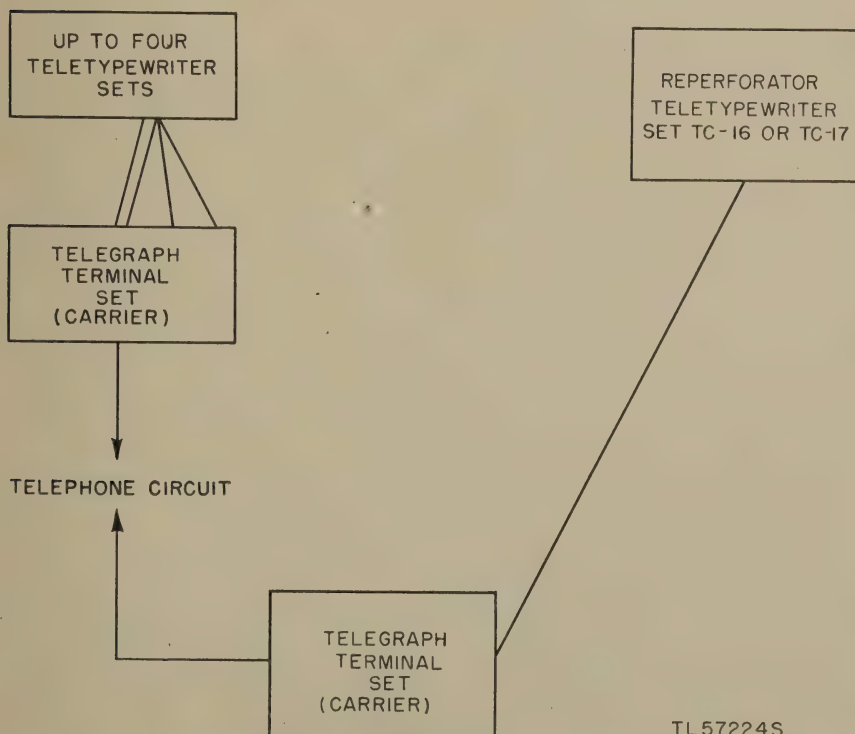
8. Use Over Long Distances

Reperforator Teletypewriter Sets TC-16 and TC-17 are often made parts of systems for communication over great distances, sometimes connected into systems that may operate over carrier or radioteletype systems. Figure 11 illustrates combinations of telegraph and telephone equipment connected between the teletypewriter sets. Further information concerning operating relationships between the various equipments and other systems is given in later sections of this manual and in technical manuals covering equipment with which Reperforator Teletypewriter Sets TC-16 and TC-17 are used.



TL 57222S

Figure 10. Reperforator teletypewriter sets connected with other equipments through means of a teletypewriter switchboard.



TL 57224S

Figure 11. Reperforator Teletypewriter Sets TC-16 and TC-17 as parts of system for communication over long distances.

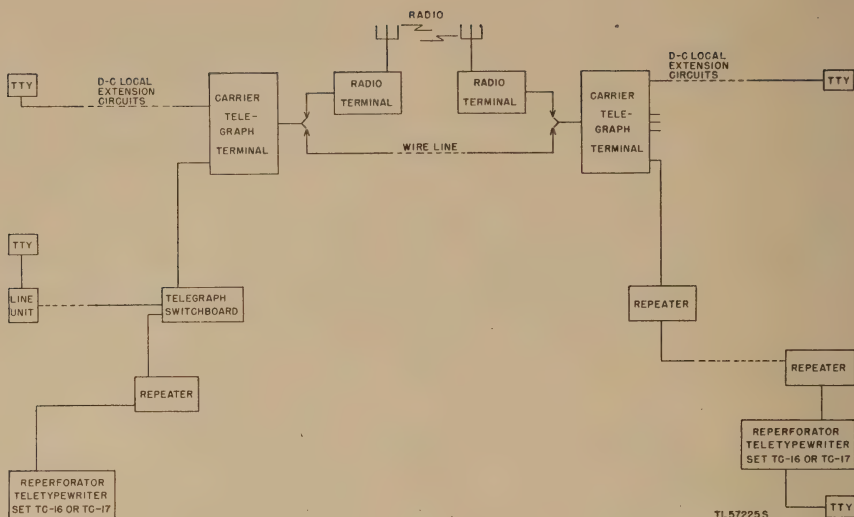


Figure 12. Reperforator Teletypewriter Sets TC-16 or TC-17 in wire and radio transmission circuits.

9. Data for Planning Installations

a. GENERAL. Assuming that equipment is correctly arranged for the particular type of connecting facilities, satisfactory teletypewriter service at the rate of 60 words per minute generally can be obtained for distances exceeding limits for satisfactory telephone conversation on like facilities. Reperforator Teletypewriter Sets TC-16 and TC-17 are designed to operate with a line relay or terminal equipment located nearby and with intermediate repeaters or switchboards when they are required.

b. APPROXIMATE TRANSMISSION LIMITS. The limiting length of a telegraph circuit, either wire or radio, is, in general, reached when a signal becomes too weak to actuate the receiving apparatus properly, the time distortion of the telegraph impulses is excessive, or the received signal strength is too low to override interference. Usually circuits can be extended by insertion of repeaters before limiting lengths of circuits are reached. Such repeaters in d-c telegraphy involve reception of signals by means of a relay and automatic retransmission using a local source of energy, such as batteries and rectifiers. In carrier or radio telegraphy, the signals may be converted to d-c form before retransmission, or the repeaters may be vacuum-tube devices to merely amplify them. In teletypewriter operation, regenerative repeaters may be used at intermediate points to retransmit received signals in substantially perfect form if they have not become too distorted. The punching of a tape by the reperforator and retransmission by the transmitter distributor are also means of regenerating signals and extending the range of teletypewriter systems.

(1) *D-c line sections.* Distances over which operation can be completed satisfactorily are limited by different considerations for different types of circuits and operating conditions. Line leakage, line resistance, ground resistance, waveshape distortion, and interference are important factors. Recommended limits for line sections vary. Statistics given here are based on severe conditions, such as a capacity to ground of 0.8 microfarad (mf) per mile and a leakage of $\frac{1}{4}$ megohm per mile for field wire, and for open wires the same leakage to ground and leakage between wires. Average or moderate interference is assumed.

(a) When the transmission facility is simplexed, d-c ground-return, neutral, with Line Unit BE-77-(*) used, transmission is sometimes possible over 40 miles on Wire W-110-B with no intermediate repeater. With Wire W-143, 35 miles is set as a limiting length for like facilities. The range for Wire W-143 can be increased by reducing the voltage of the line current or by adjusting the line unit relay to compensate for the distortion of the signals.

(b) When the transmission facility is simplexed, d-c ground-return, neutral, with Line Unit BE-77-(*) in use, the distance from *one* intermediate telegraph repeater or *one* telegraph switchboard to each teletypewriter station should not exceed 25 miles when Wire W-110-B or Wire W-143 is used.

(c) When the transmission facility is simplexed, d-c ground return, polar or polarential, with telegraph repeaters used at the teletypewriter set, transmission over a section in which there is no intermediate repeater is possible over Wire W-110-B for 50 miles and over Wire W-143 for 75 miles. With 19-gauge cable the section distance can be extended to 125 miles, and with 165-mil copper composited open wire, transmission for 200 miles is not uncommon.

(2) *Local d-c extensions of carrier circuits.* (a) With ground-return, polar or polarential type of operation with carrier terminals in use, and the circuit usually simplexed with Wire W-110-B, distances between repeater points can usually be 25 miles. With Wire W-143 the distances between repeater points can be extended to 40 miles. When the type of operation is ground or metallic return, polar or neutral with carrier terminals in use, any type of circuit to a teletypewriter with fixed-bias line relay sections is generally no longer than 5 miles. With ground-return, neutral type of operation a local extension of Telegraph Terminal CF-2-A with any type circuit to a Line Unit BE-77-(*), an average transmission distance for one section with no intermediate repeater is generally 25 miles and as an extension of Telegraph Terminal CF-2-B about 16 miles. With ground-return, neutral operation and as an extension of Telegraph Terminal CF-2-A, any type of circuit, to a Switchboard BD-100, 25 miles generally is a section length, while for an extension of Telegraph Terminal CF-2-B such a hook-up will ordinarily work efficiently only over a distance of about 12 miles.

(b) Recommended limits for the length of d-c line sections and of local d-c extensions of carrier circuits for 60-word-a-minute service are given in detail in TM 11-486.

(3) *Carrier line sections.* The limiting length for carrier telegraph sections is generally set by the requirement that the telephone circuit involved be suitable for furnishing good telephone service. However, the maximum loss should not exceed about 25 decibels (db) between telegraph terminals. If extensions from the telephone terminals to the telegraph terminals are involved, these should not be noisy and should not have loss in excess of about 8 db each. Several carrier telegraph sections may be included in a multi-section network, provided the over-all limiting coefficient is not exceeded.

(4) *Teletypewriter operation on radio.* Reperforator Teletypewriter Sets TC-16 and TC-17 may be used as parts of a system providing teletypewriter operation on radio. A single-channel teletypewriter system is available for operation over distances from a few hundred to several thousand miles using radio teletype terminal equipment. Further details of this type of operation appear in TM 11-354, TM 11-2203, TM 11-2209, and TM 11-680 (when published).

10. General Functioning of Teletypewriter Sets TC-16 and TC-17

a. TRANSMISSION FEATURES. Reperforator Teletypewriter Sets TC-16 and TC-17 may be used to transmit directly to the line and monitor the message by printing on and perforating a tape. When tape transmission only is desired, the typing reperforator may be operated locally and the tape thus perforated used for operating the transmitter distributor. The typing reperforator may also be connected to the circuit so as to receive signals from a distant point to prepare tape for subsequent transmission.

b. ARRANGEMENT. The typing reperforator, transmitter distributor, and connection or jack box are secured to the base of the chest. The typing reperforator and transmitter distributor are provided with resilient mounts. Covers of these two units latch to their respective bases. The chest cover, when removed and placed on its side, provides a support for the chest base with operating equipment. Hinged panels within the cover may be swung into position so as to form a storage compartment for perforated tape (fig. 2) that may accumulate between the typing reperforator and transmitter distributor. The reperforator teletypewriter sets are arranged so that they may be quickly connected without the use of special tools into teletypewriter systems in which the sets are used. The connection or jack box is equipped with two power cords with plugs (one for motor power and the other for local direct current, two receiving line cords with plugs, and two sending line cords with plugs.

Each signal line cord is connected to a pair of jacks wired in series. The typing reperforator is equipped with two line cords with plugs and the transmitter distributor with one. These plugs may be plugged into the connection box.

c. POWER SOURCES. The governed series motors require a 115-volt, 225-watt (total) source of either d-c or 25- to 40-cycle, or 50- to 60-cycle a-c. It is preferable to operate the motors on a-c, although satisfactory motor operation usually may be obtained on any stable voltage between 105 and 125 volts. The local operating circuits of the jack box require a 105- to 125-volt, 25-watt source of direct current.

d. SIGNAL CIRCUITS. The keyboard transmitting contacts of the reperforator are connected to a cord with a black shell plug, and the selector-magnet coils are connected to a cord with a red shell plug. The contacts of the transmitter distributor are connected to a cord with a gray shell plug. The jack box, which is mounted on the rear of the reperforator (fig. 4), makes it possible to arrange the typing reperforator, transmitter distributor, and other available teletypewriters in a number of operating combinations.

e. MOTOR STOP. The reperforator is not arranged to stop the motor upon receipt of the H signal when the platen is in figures position. The machine prints the English pound sterling symbol when the platen is in this position.

f. END-OF-LINE INDICATOR. The reperforator end-of-line indicator signal lamp (fig. 2) is adjusted to operate on Reperforator Transmitter TG-26-A when approximately 65 characters have been perforated, indicating that associated page teletypewriters are nearing the end of a line of type. On Reperforator Transmitter TG-27-A the end-of-the-line indicator signal lamp (fig. 2) is adjusted to operate when approximately 69 characters have been perforated, indicating that associated page teletypewriters are nearing the end of a line of type.

g. UNSHIFT-ON-SPACE FEATURE. The reperforator is adjusted to shift the platen to the letters position upon receipt of a space bar signal.

h. REPEATED SPACE. The reperforator will continue to perforate the tape with and transmit the code for spaces as long as the space bar is depressed.

i. SPEED. The reperforator and transmitter distributor motors are equipped with adjustable centrifugal governors. The governors are normally adjusted for a speed of 368 opm (American speed). They may be adjusted for 404 opm, which is the speed of British teletypewriter equipment. Motor speed is set by qualified maintenance personnel, using a tuning fork furnished as a part of teletypewriter maintenance equipment.

j. POWER SELECTOR SWITCH. A three-position power selector switch is mounted on the side of the jack box (fig. 4). This switch, together with

suitable resistances located within the jack box, permits operation of the motors on various sources of power as outlined in *c* above.

k. RIBBON-LIFT LEVER. The ribbon-lift lever on the reperforator (fig. 2) lifts the inking ribbon away from the tape to permit seeing the last character printed without using the tape feed-out or space functions of the machine.

l. BACK-SPACE LEVER. Operation of the back-space lever (fig. 2) feeds the tape back through the punching mechanism and tape guides. The tape is moved back one space for each operation of the lever.

m. TAPE FEED-OUT LEVER. A tape feed-out lever is located on the upper left-hand side of the reperforator (fig. 13). Operation of this lever causes the tape-feeding mechanism to feed out tape as long as the control is operated. The tape will be perforated with the code of the LTRS function as it passes through the punching mechanism.



Figure 13. Reperforator Transmitter TG-26-A, cover lifted.

n. TIGHT TAPE STOP ROD. The tight tape stop rod located to the right of the transmitter distributor (fig. 13) stops the tape-feed and transmitting mechanism of the transmitter distributor if there is tight tape between the reperforator and the transmitter distributor. The tight tape stop rod will also stop the tape-feeding mechanism if the tape feeding

into the transmitter becomes tangled, thus preventing the tape-feed wheel perforations from being torn or mutilated.

o. TAPE OUT ALARM. The reperforator is equipped with a bell to indicate when the tape is near the end. It is adjusted to operate when the diameter of the tape roll is reduced to a point where a red tinge appears on the tape passing through the machine, or shortly thereafter. The position of the arm which bears on the tape roll within the tape container controls the ringing of the bell.

p. TAPE. Tape perforated by the typing reperforator is the chadless type; that is, the perforations are not punched out of the tape in a complete circle, but each punching or chad is hinged at the leading edge (fig. 14). This makes it possible for the typewritten character to be read easily because no parts of the typewritten letters are missing on the tape. This method also does away with the need of having containers to catch chads and avoids the possibility of chads clogging the reperforator mechanism. The transmitter distributor will transmit from old style, completely perforated tape as well as from chadless tape.

q. PERFORATING AND TYPING. The tape is perforated as it passes through the punch block. The platen is a piece of steel which has a rubber insert over which the tape passes as the type characters strike an inked ribbon. The punch block is located at such a distance to the left of the platen that the typed letter is printed on the tape six spaces behind the coded perforation for this letter (fig. 14). Because a printed letter is always six operations behind its coded perforation, be careful when tearing off the tape. Allow enough starting space for the next message.

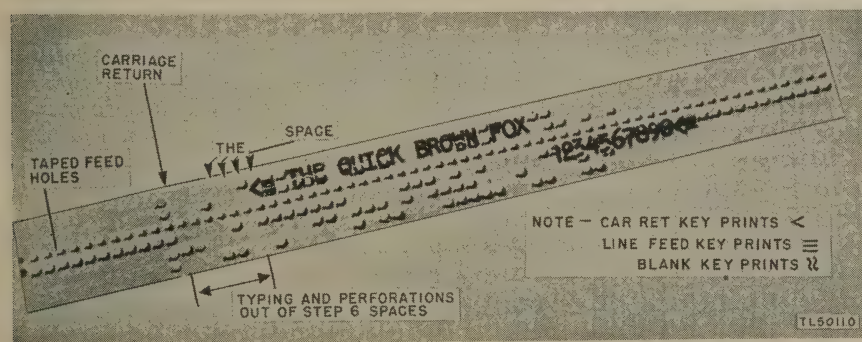


Figure 14. Typing reperforator tape sample.

Section III. ASSEMBLY, INSTALLATION, AND DISASSEMBLY

11. Selecting Location

a. Select a dry, covered location, having in mind provisions for black-out operations on either a point-to-point or network basis. A location with

a suitable commercial or military source of power is required. When ground-return circuits are to be used, a location suitable for a good low-resistance ground connection is preferred.

b. Locate the equipment where traffic can be handled as efficiently as possible with maximum protection for the equipment and operating personnel.

c. When the teletypewriter set is to be located with or near other equipment, arrange it in convenient alinement to prevent confusion in operating and maintaining the equipment. Wiring and cabling between the units and to other equipment or systems, cable terminals, and wire facilities should be carried overhead when possible. Sometimes it is well to use a conduit or boards to avoid possibilities of damage. At other times it may be advisable to bury wiring and cables if no other suitable protection is available.

12. Uncrating, Unpacking, and Checking

Use particular care when handling and unpacking equipment which may be easily damaged. A good procedure to follow when unpacking teletypewriter equipment is as follows:

a. Place the packing cases containing equipment as near the operating position as possible.

b. Cut the steel or wire straps that encircle the packing case.

c. Use a nail puller to remove nails, and remove the sides of the packing cases. *If attempts are made to pry off the sides, damage to the equipment may result.*

d. Carefully remove the top of the cases and all protective wrappings.

e. Remove individual chests and cartons and check the contents of each with the lists of components, tools, accessories, spare parts, etc.

Caution: Be extremely careful not to remove or damage weather-proofing coatings which may have been applied to the equipment.

13. Assembly

a. REPERFORATOR TRANSMITTER. (1) Remove the carrying case cover.

(2) Use the cover as a table, placing it in position as shown in figure 1, with the side having the tape trap door uppermost.

(3) Place the base of the carrying case on the cover so that the tape trap doors in the base and cover line up properly.

(4) Unlatch the left-hand side of the tape loop compartment and swing the panel forward until the latch snaps in place. Then proceed in similar manner with the right-hand side of the tape loop compartment.

(5) Open the tape trap doors in the base and cover of the carrying case.

(6) Remove all plugs from jacks of the connection box.

b. **LINE UNIT.** Remove the line unit from its packing chest. Place the line unit in a convenient position for operation of its controls. Position it within reach of the line cords from the jack box of the reperforator transmitter and in such a way that it may be connected as shown in figure 1.

c. **RECTIFIER.** When the set-up is one in which a rectifier is used, remove the rectifier from its packing case and place it on top of the chest and within reach of the d-c power cord from the jack box of the reperforator transmitter (fig. 1).

Note. In the assembly procedure described in the subparagraphs above, it was assumed that the units were in normal working order when they were packed for transportation. When the units are unpacked from shipping containers, checks and adjustments outlined in paragraph 14 should be completed before the units are completely assembled.

14. Physical Checks and Adjustments

a. **REPERFORATOR TRANSMITTER.** At the time the equipment is unpacked and assembled, and in all cases before the reperforator transmitter is connected to other equipment, check the following:

(1) General physical condition of the entire unit to determine that no damage occurred during shipment. When damaged apparatus is received, complete repairs, if possible, in accordance with instructions in part five of this manual; otherwise return the equipment for replacement as directed by the local commanding officer.

(2) The entire unit to see that no excelsior or other packing material has become lodged in moving parts.

(3) All mechanical parts for lubrication.

(4) Motor, fuse, switches, cords, and plugs to make sure that all connections and moving parts are in satisfactory condition. *Turn the motor over by hand before applying power.*

(5) At least one teletypewriter ribbon will be furnished with each typing reperforator. See TM 11-2223 for instructions on installing new ribbons. Normally tape is supplied with the reperforator transmitter unit. Check to see that it has been supplied.

b. **LINE UNIT.** As in the case of the reperforator transmitter, check to see that the unit has not been damaged in shipment. Remove any accumulations of wood fiber or packing paper. Check to see that the fuse and lamp are in their proper places, and that no parts appear bent, broken, or otherwise damaged.

c. **RECTIFIER.** Make certain that all wiring is in place. Inspect the plug to see that it has not been damaged and the receptacle to establish that there are no bent contacts. Make sure that there is no dirt or dust between the radiating disks of the rectifier stack. Check both a-c and d-c

fuses. The d-c fuse is located on the tap-changing panel. The a-c fuse is located underneath the chassis behind the OFF-ON switch (fig. 7). Check to see the power cord plug is in condition to make good contact.

15. Disassembly and Packing

a. There is little to repacking the various units of Reperforator Teletypewriter Set TC-16 or TC-17. After the reperforator transmitter set has been prepared for transportation, the respective units, the reperforator transmitter set, the line unit, and the rectifier are returned to their original shipping cartons if these cartons are available. The following steps are suggested in preparing the reperforator transmitter set for transportation:

- (1) Disconnect the connection box cords from the line terminal equipment and power supplies.

- (2) Plug the transmitter distributor and connection box line cords into jacks on the connection box and carefully fold the cords and place them between the typing reperforator cover and the transmitter distributor.

- (3) Plug the typing reperforator line cords into jacks on the connection box and carefully fold the cords and place them between the typing reperforator cover and the connection box.

- (4) Clamp the two ends of the power cords in the clamp provided in the rear of the transmitter distributor and place the cords between the typing reperforator and the transmitter distributor.

- (5) Close the trap doors in the base and the cover.

- (6) Latch the compartment panels against the walls to which they are hinged.

- (7) Secure the cover to the chest base.

b. If the shipping boxes in which the reperforator teletypewriter sets were originally shipped are not available, and if shipment is to be for export, the containers in which the respective units have been placed are first wrapped with heavy wrapping paper similar to the waterproof barrier in which they were originally packed. The containers are then packed into strong wooden boxes and are cushioned with excelsior or similar material to prevent shifting. The excelsior should be at least three inches thick between the sides of the box and all parts of the equipment. Securely nail the cover on the box and strap with metal tape or strong wire.

c. Mark clearly on the outside of the box containing repacked equipment the equipment contained, its condition, whether or not it has been weatherproofed, and the date of the last weatherproofing treatment. Obliterate all marks on the box used which do not pertain to the equipment.



Figure 15. Typical waterproof barrier.



CHAPTER 2

OPERATING INSTRUCTIONS

Section IV. EQUIPMENT CONNECTIONS

16. Connections to Line and Other Equipment

The connection (jack) box (fig. 4), part of the reperforator transmitter assembly, is equipped with two power cords with plugs, one for motor power and the other for local d-c, two receiving line cords with plugs, and two sending line cords with plugs (send and receive for line 1 and send and receive for line 2) which are inserted into the jacks of the line unit for connection to the signal lines. Each of these send and receive cords is wired in series to a pair of jacks mounted in the jack box. The typing reperforator is equipped with two line cords and plugs (send and receive) and the transmitter distributor with one (send). The plugs may be inserted into the connection box jack for connection to the signal lines.

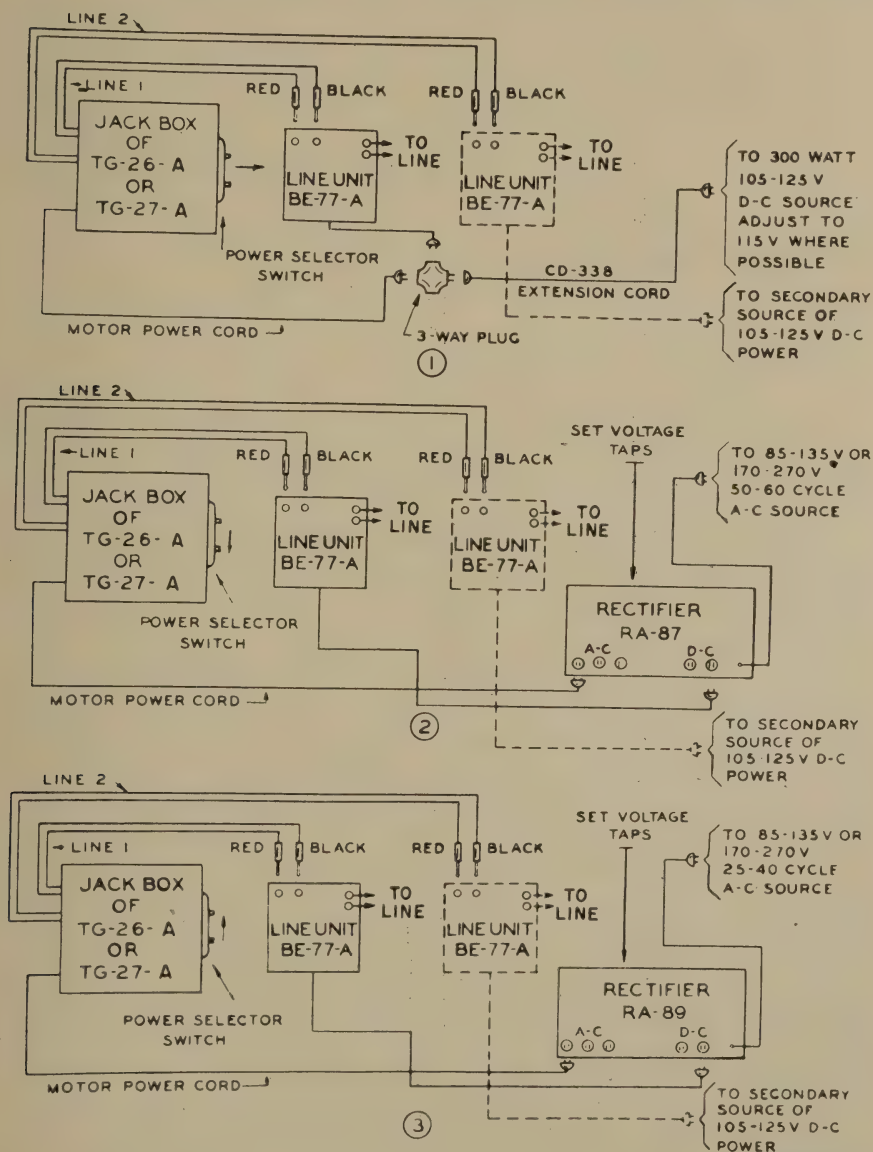
a. POWER CONNECTIONS. (1) Be sure the power selector switch on the right-hand side of the jack box (fig. 4) and the rectifier input-voltage taps are set for the type and voltage of power source to be used and that the rectifier power switch is OFF.

(2) For operation on the usual 115-volt d-c or 50- to 60-cycle a-c power source, connect the power cords of the reperforator transmitter and the line unit (or line units) and rectifier as shown in the applicable part of figure 16. When more than one line unit is required, as in the operating arrangements shown in figures 22, 23, and 26, connect additional line units (indicated by dotted lines) to secondary sources of d-c power to avoid crossfire effects between lines. Secondary sources of d-c power can be another Rectifier RA-87 or RA-89; Rectifier RA-37; or Power Unit PE-77-(*), one or more of which may be available if other teletypewriter sets are operated in conjunction with the reperforator teletypewriter set.

Note. Never connect more than two line units to one Rectifier RA-87 or RA-89. When two line units are to be connected to a common d-c power source, be sure to pole the connections properly before the ground wire is attached to the GND binding post of the line unit to prevent short-circuiting the power supply. Obtain the proper polarity by connecting the power cords so that the meters of both line units (if they are Line Units BE-77-A or BE-77-B) deflect in the same direction. If Line Units BE-77 are used, make power, line, and ground connections to each line unit separately to check polarity before the common connections to the d-c power source are made.

(3) When it is necessary to supply direct current to the local circuits of the jack box, as shown in the operating combinations indicated in figures 21, 23, 24, 25, and 27, connect the d-c power cord from the jack box to any source of 115-volt d-c power. However, if the source is a rectifier, do not connect more than one line unit to the rectifier in addition to the d-c power cord of the jack box.

(4) When the set is to be connected to short lines and only 115-volt, 25-, 40-, or 50- to 60-cycle power is available (using no rectifier), it is



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Figure 16. Usual power cording connections.

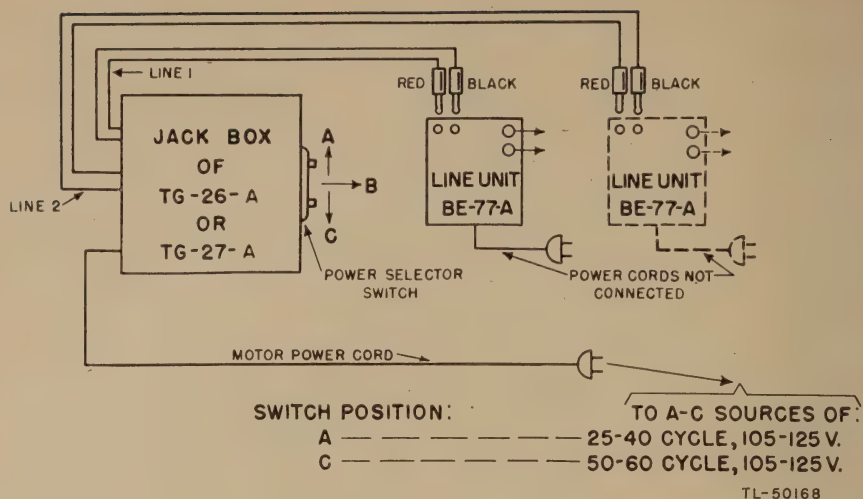


Figure 17. Emergency power cording connections.

frequently possible to operate the reperforator teletypewriter set with power arrangements shown in figure 17.

b. ESTABLISHMENT OF GROUND CONNECTION. It is highly essential that a good low-resistance ground connection be obtained for satisfactory operation of teletypewriter equipment over ground-return circuits. This is particularly true when one ground connection is used as a return for more than one line, because a high ground resistance introduces crossfire effects between lines. Whenever it is possible, connect the ground lead for teletypewriter equipment over ground-return circuits to a water pipe (on the street side of the meter) or equivalent low-resistance ground connection. When this is not possible, an efficient ground arrangement may be obtained by driving one or more ground rods deeply into damp ground and connecting them to the line-terminating equipment with field wire. If it is necessary to drive more than a single rod, additional rods may be driven at a considerable distance from the teletypewriter set, up to 1,000 yards if necessary, to receive good ground connection. Additional resistance of a field-wire lead may be considered to form only a small part of the total ground-return resistance. Drive ground rods so that good contact is made between the rods and the soil. Avoid hard blows to prevent whipping of the rod. Such whipping causes poor contact between the rod and the soil. To get a good ground connection, proceed as follows:

- (1) Select the lowest, dampest site in the vicinity. Clay or loamy soil is best.
- (2) Scoop out a hole about 6 inches deep in the selected location.
- (3) Drive a rod that is free from paint or grease in the hole until

the top of the rod is approximately 3 inches above the surface of the soil at the top of the hole.

(4) Clamp the lead wire securely to the ground rod. Saturate the earth around the rod with water, and fill the hole with earth, covering the top of the rod. Keep the earth around the rod moist by frequent applications of water.

(5) If a satisfactory low-resistance ground is not obtained when the procedure outlined in the above subparagraphs has been followed, drive additional ground rods in parallel. Do not have spacing between the adjacent rods less than 10 feet.

(6) If multiple ground rods in parallel fail to provide adequate low ground resistance, treat the soil around the rods. Dig a basin 3 feet in diameter and 1 foot deep around each ground rod. Mix a solution consisting of 5 pounds of salt and 5 gallons of water for each rod. Pour this solution into the basin and allow it to seep through the soil. In half an hour, or as soon as the solution has seeped through the soil, check connections and fill the basin with excavated soil, packing it in as solidly as possible. For further information as to grounds and grounding, see TM 11-755. Figure 18 illustrates a method for treating soil to obtain a satisfactory ground.

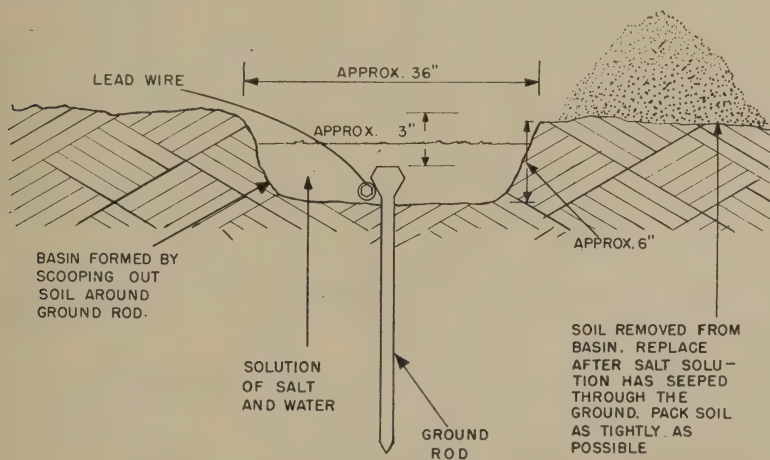


Figure 18. Artificial treatment of a ground connection.

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c. GROUND CONNECTIONS. (1) Attach the wire from a good low-resistance ground to the GND binding post of the line unit if only a single line unit is used.

(2) To avoid possibility of electrical shock to operating personnel and to reduce interference from the motor circuits, connect an earth ground to the binding post marked EARTH CONNECTION on the lower left-hand side of the jack box. *Never* connect this binding post to the ground connections used for ground-return signal circuits unless it is a low-resistance connection such as a water pipe; use a separate ground rod.

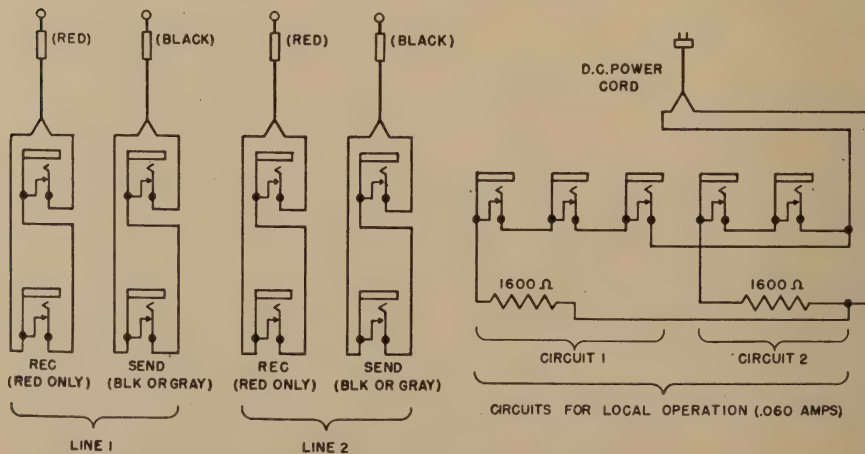
17. Signal Circuit Connections

a. The jack box allows for various operating combinations without it being necessary to disturb connections made to the line units. The jack box furnishes a pair of circuits for local operation (fig. 19). One of these, circuit 1, has three closed-circuit jacks wired in series with a fixed 1,600-ohm resistor connected to a d-c source of 115 volts. Local circuit 2 is like circuit 1, excepting that it has only two jacks. The fixed resistors in each of the circuits limits the circuit current to approximately 60 ma. Two multiple circuits (sending and receiving) are furnished for operating over one or two lines. Each of these circuits consists of two closed-circuit SEND and REC jacks connected in series with SEND and REC line cords which terminate in black and red shell plugs for connection to line units or other line-terminating equipment. Figure 19 shows jack box connections and figure 20 shows the usual signal cording connections. Figure 28 is a wiring diagram of the jack box.

Note. When local circuits of the jack box are used, connect with the d-c power cord from the jack box to a source of 105-125-volt direct current.

b. Some of the numerous operating combinations in which the typing reperforator, transmitter distributor, and a page-printing teletypewriter may be arranged are shown in figures 21 to 27, inclusive. The text associated with these figures describes the necessary signal circuit cord connections between the respective units, the jack box, and line units. TM 11-359 describes the method of making line connections to the line units. When more than one line unit is required, as in the case of some combinations illustrated, additional line units may be secured from teletypewriter sets associated with the installation. In the diagrams reproduced here TD means transmitter distributor, TR typing reperforator, K keyboard, and TTY teletypewriter.

c. The first of these combinations, preparing perforated and printed



TL-50166

Figure 19. Jack box connections.

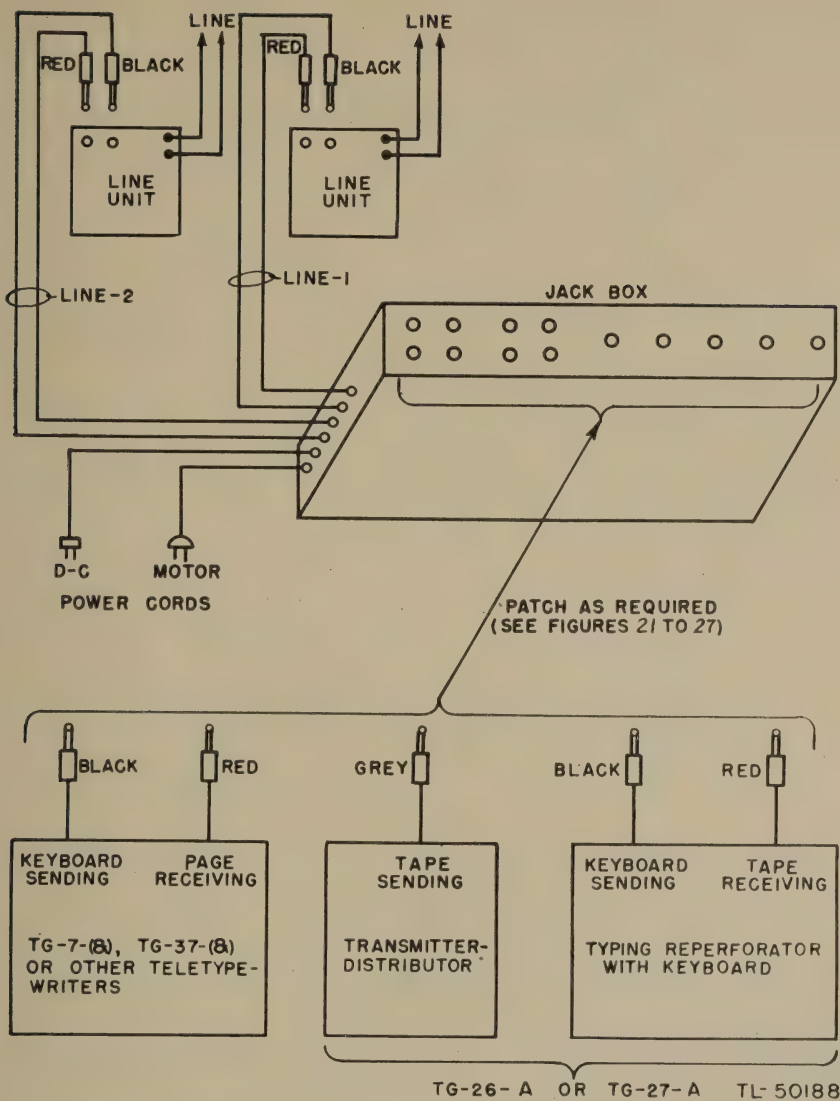


Figure 20. Usual signal cording connections.

tape locally and transmitting simultaneously to the line from the tape is shown in figure 21. It is necessary to make the following jack box connections:

(1) Insert the red and black plugs of the reperforator in the jacks of local circuit 1.

(2) Insert the gray plug of the transmitter distributor in the SEND jack of line 1 or 2 as required.

d. Figure 22 indicates the combination of sending from the keyboard to the line or receiving from the line (making perforated and printed tape on either operation), and transmitting simultaneously to another line



Figure 21. Preparing tape locally and transmitting simultaneously to line from tape.

from tape (the station functioning as a repeater). For this combination, make the following jack box connections:

- (1) Insert the red and black plugs of the reperforator in the REC and SEND jacks of line 1 or 2 as required.
- (2) Insert the gray plug of the transmitter distributor in the SEND jacks of the remaining line.



Figure 22. Sending from keyboard to line or receiving from line (making tape on either operation) and transmitting to another line from tape. Station functions as repeater.

e. Figure 23 shows a combination of sending from the teletypewriter keyboard to the line or receiving from the line (making page copy on either operation); simultaneously preparing a perforated and printed tape locally, and transmitting simultaneously to another line from tape. To accomplish this combination, the following are the proper jack box connections:

- (1) Insert the red and black plugs of the page teletypewriter in the REC and SEND jacks of line 1 or 2 as required.
- (2) Insert the red and black plugs of the reperforator in jacks of local circuit 1.
- (3) Insert the gray plug of the transmitter distributor in the SEND jack of the remaining line.

f. To send from the keyboard to the line or to receive from the line (making perforated and printed tape on either operation) and to prepare simultaneously page copy locally from perforated tape previously obtained from any source (fig. 24), the jack box connections should be as follows:

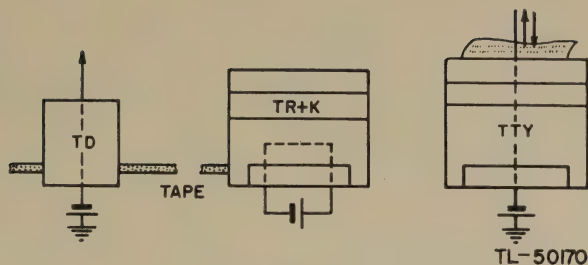


Figure 23. Sending from teletypewriter keyboard to line or receiving from line (making page copy on either operation); simultaneously preparing tape locally, and transmitting simultaneously to another line from tape.

- (1) Insert the red and black plugs of the reperforator in the REC and SEND jacks of line 1 or 2 as required.
- (2) Insert the gray plug of the transmitter distributor in a jack of local circuit 1.
- (3) Insert the red plug of the page teletypewriter in a jack of local circuit 1.

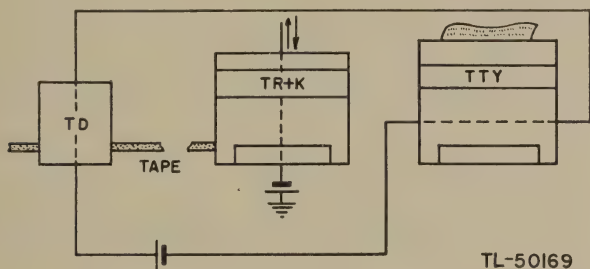
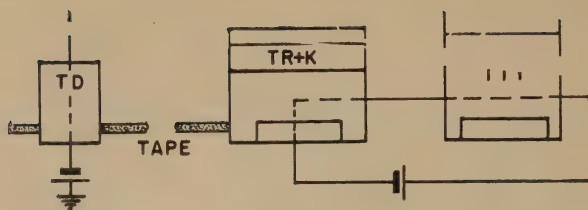


Figure 24. Sending from keyboard to line or receiving from line (making tape on either operation) and preparing simultaneously page copy locally from perforated tape previously received from any source.

g. In figure 25 the combination shows preparation of perforated and printed tape plus page copy locally and transmission simultaneously to line from tape. The following jack box connections are made in this combination:

- (1) Insert red plugs of the reperforator and page teletypewriter in jacks of local circuit 1.
- (2) Insert the black plug of the reperforator or page teletypewriter, depending on which keyboard it is desired to use, in the remaining jack of local circuit 1.
- (3) Insert the gray plug of the transmitter distributor in the SEND jack of line 1 or 2 as required.

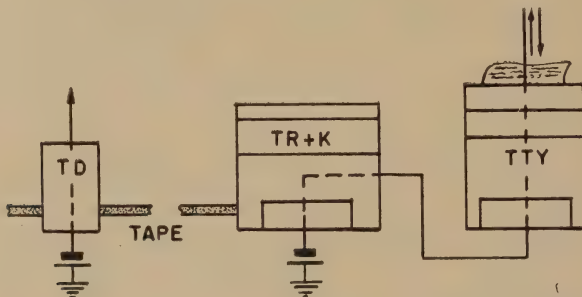
h. When sending from the keyboard of either reperforator or page teletypewriter to line and receiving from line (making tape and page copy of either operation) and transmitting simultaneously to another line from tape (fig. 26), the following jack box connections must be made:



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Figure 25. Preparing tape plus page copy locally and transmitting simultaneously to line from tape.

- (1) Insert the red and black plugs of the reperforator and page teletypewriter in the REC and SEND jack of line 1 and 2 as required.
- (2) Insert the gray plug of the transmitter distributor in the SEND jack of the remaining line.

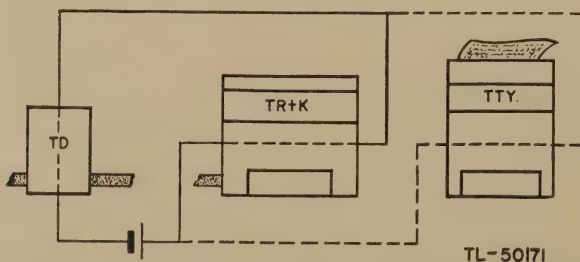


TL-50173

Figure 26. Sending from keyboard of either reperforator or page teletypewriter to line and receiving from line (making tape and page copy on either operation) and transmitting simultaneously to another line from tape.

i. The combination shown by figure 27 is that of preparing perforated and printed tape or page copy, or both, from previously prepared tape. The following are the jack box connections:

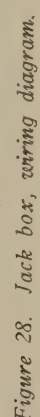
- (1) Insert the gray plug of the transmitter distributor in a jack of local circuit 1.
- (2) Insert the red plug of the reperforator or page teletypewriter, or both, depending on the copy desired, in the remaining jacks of local circuit 1.



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Figure 27. Preparing tape or page copy, or both, from previously prepared tape.

Figure 1 is a schematic diagram of the control system for the local operation of the 200 amperes. The diagram is divided into two main sections: 'CIRCUIT 1' and 'CIRCUIT 2'. Each circuit contains a series of relays and switches. The relays are labeled 'RECEIVING (RED)' and 'SENDING (BLACK)'. The switches are labeled 'RECEIVING (RED)' and 'SENDING (BLACK)'. The diagram also shows a '1600L' component and a '1600R' component. The entire system is controlled by 'LINE 1' and 'LINE 2'.



Section V. OPERATING CHECKS AND ADJUSTMENTS

18. Preoperational Checks and Adjustments

a. **TYPING REPERFORATOR.** All typing reperforators are adjusted properly at the factory before shipment. However, before putting new or used equipment in operation, inspect the equipment and, if necessary, lubricate it in accordance with instructions in TM 11-2223, when published. Whenever definite information is not available on the condition of the equipment, check to be sure that none of the adjustments has shifted. Check the following items, and any other items observed to be in questionable condition:

- (1) The motor speed (TM 11-2223).
- (2) The clutch lever contacts (TM 11-2223).
- (3) The tape-feed pawl (TM 11-2223).
- (4) Make sure that the ribbon-reverse shaft is fully engaged with one of the ribbon feed shafts.
- (5) See that the tape reel is free on its axis and that the tape feeds properly.
- (6) See that ribbon in the typing reperforator functions properly. For instructions on replacing ribbon, refer to TM 11-2223.
- (7) Check to see that there is an ample supply of tape in the reperforator. If additional tape is necessary, refer to TM 11-2223 for instructions for installing it.

- (8) Check the range finder setting (TM 11-2223).

Note. For further information regarding checks and adjustments involving the reperforator, refer to TM 11-2223.

b. **TRANSMITTER DISTRIBUTOR.** (1) Check that there is no bind in the motor when it is turned by hand in the direction of normal rotation (distributor brushes revolving clockwise).

(2) See that the distributor brushes are making contact with the commutator segments and that the brushes have proper tension and position with respect to the reference line on the distributor disk.

(3) Check the action of the tape stop arm, the tape-feed mechanism, and the tape-sensing mechanism.

(4) Check motor speed. If adjustment is necessary, follow instructions given in TM 11-2222.

(5) Test the transmission control circuit. With the transmitter distributor send copy to a receiving teletypewriter, throw the tape-stop switch to OFF (or STOP). Transmission should stop immediately. Throw the switch to ON (or SEND); transmission should resume without error. Other tests for the circuit are outlined in TM 11-2222.

c. **LINE UNIT BE-77-A.** (1) Check that none of the parts of the line unit are broken or defective.

(2) Check that the fuse is in place and that the neon lamp BLOWN FUSE indicator is functioning.

- (3) Determine, connect, and check the power source (TM 11-359).
 - (4) Check connections of the teletypewriter equipment to the line unit (TM 11-359).
 - (5) Check the ground connection if a ground-return circuit is to be used.
 - (6) Check the line connection and adjust the line current and relay bias as outlined in TM 11-359.
- d.* RECTIFIER RA-87. (1) Check the rectifier for loose or broken parts. Shake it to see if any loose parts can be detected. Repair any defects discovered.
- (2) Check the power source (TM 11-957).
 - (3) Set the movable PRI lead on the tap-changing panel to the terminal most nearly corresponding to the voltage of the power source as outlined in TM 11-957 before connecting the rectifier.
 - (4) Check a-c and d-c fuses, being sure to turn ON-OFF switch to OFF before removing the fuses.
 - (5) Check connecting cords for worn or broken places.
 - (6) See that all plug contacts are tight.

19. Initial Line-Up Procedure

- a.* Make the connection to the LINE binding post of Line Unit BE-77-A (TM 11-359). If more than one line unit is to be used, connect each additional line to a separate line unit.
- b.* Connect SEND and REC cords for LINE 1 from the connection or jack box of the reperforator transmitter assembly to the PRINTER jacks of the line unit. If two line units are used, connect LINE 2 cords from jack box to PRINTER jacks of the second line unit (fig. 20).
- c.* Insert the red and black plugs of the reperforator and the gray plug of the transmitter distributor in jacks of local circuit 1 in the jack box. Insert the red and black plugs of the page teletypewriter (if one is used) in the jacks for local circuit 2.
- d.* Start all teletypewriter motors and check to see that the machines function correctly in local circuits.
- e.* Check the d-c voltage, using the METER key on the line unit or line units, if more than one is used. Adjust voltage to 115 volts if necessary while all motors are running (TM 11-957).
- f.* Adjust line current in each line to 60 ma while the motors are running (TM 11-359). Insert reperforator cords in the jacks of line 2 and adjust line relays for zero bias.
- g.* When this initial line-up has been completed, connect the signal circuit cords of the reperforator transmitter distributor and any associated teletypewriters in accordance with instructions for desired operating combinations described and illustrated in section IV.

20. Check of Local Operation of Line Unit

a. Throw the left-hand toggle switch of the line unit to RELAY IN CIRCUIT.

b. Throw the right-hand toggle switch to DISTANT CURRENT SUPPLY. This removes the power supply voltage from the LINE and GND binding posts.

c. Turn the LINE RHEOSTAT to its extreme counterclockwise position (IN).

d. Connect the LINE binding post to the GND binding post with a short length of insulated wire.

e. Throw the right-hand toggle switch to LOCAL CURRENT SUPPLY and adjust the LINE RHEOSTAT for a reading of 60 on the meter.

f. Check operation of the teletypewriter equipment. Adjust the white knob on the relay until satisfactory operation is obtained. Check operation of the teletypewriter equipment without using the line relay by throwing the left-hand toggle switch to RELAY OUT OF CIRCUIT.

Note. Do not attempt a line-up of the line unit until satisfactory local operation is obtained.

21. Check of Ground Connection for Line Unit

a. SINGLE GROUND CONNECTION. Do not test single ground connections to water pipes and similar objects. To check them, install a ground rod or other separate ground; then make a test by using the connection as a double ground connection and follow the procedure described in *b* below.

b. DOUBLE GROUND CONNECTION. (1) Connect one wire of a field wire pair from the ground rods to the LINE binding post and the other wire to the GND binding post.

(2) If the local operation check (par. 20) has not been made, perform the steps as instructed in paragraph 20*a* through *e* above. Connect the wire between the binding posts so that it can be easily removed and applied without danger of shock.

(3) Watch the meter and note the reading when the wire between the binding posts is removed.

(4) If the meter reading changes from about 60 to any value above 40 when the wire is removed, the ground connection is satisfactory (less than 240 ohms).

(5) Remove the connecting wire and connect both wires of the field wire pair to the GND binding post.

22. Line-Up Procedure with Various Types of Terminal Equipment

This paragraph and paragraph 24 contain general instructions. Paragraph 23 and paragraphs 25 to 27, inclusive, contain specific instructions

for lining up Reperforator Teletypewriter Sets TC-16 and TC-17 with the following equipments:

- a. Other Reperforator Teletypewriter Sets TC-16 and TC-17.
- b. Telegraph Printer Sets (Teletypewriter) EE-97 and EE-98 and Teletypewriter Sets EE-97-A, EE-98-A, and EE-102.
- c. Telegraph Central Office Set TC-3.
- d. Repeater Set TC-18 (Terminal, Telegraph).
- e. Telegraph Terminal CF-2-(*).
- f. Telegraph Terminal Set AN/TCC-1, Telegraph Terminal TH-1/TCC-1, and Filter F-2/GG.

Note. Official nomenclature followed by (*) is used to indicate all models of the item of equipment included in this manual. Thus Telegraph Terminal CF-2-(*) represents Telegraph Terminals CF-2-A and CF-2-B.

g. The line-up of a circuit ordinarily includes arranging for the supply of line current, adjusting line current, and adjusting relays at the ends of the circuit.

h. When a circuit from a line terminates in a switchboard, the circuit line-up is directed by the switchboard operator. When the circuit is between two stations, the station operator at the higher headquarters is in control. If the circuit is between two stations of equal authority, the control station is the one with the lower numerical designation.

i. Operators can usually communicate with one another by telephone preparatory to a circuit line-up. When they cannot, communication may be carried on by means of break signals which can be observed on the meter of Line Unit BE-77-A. The following uses of break signals are helpful in avoiding confusion during the circuit line-up:

(1) One 3-second break means: "Stop transmission. I am through with my adjustment and will send repeated space-bar signals."

(2) Two 3-second break signals sent by a control terminal mean: "Arrange to supply line current."

(3) Three 3-second break signals indicate that further line current adjustment is necessary and that additional space-bar signals are to be sent.

j. The control terminal normally supplies line current. Sometimes, however, it is necessary to supply line current from both terminals of a circuit. When only one station supplies current, the operator at the station which supplies line current should control it.

23. Line-Up Procedure for Two Equipments Using Line Unit BE-77-(*).

These equipments include Reperforator Teletypewriter Sets TC-16 and TC-17, Telegraph Printer Sets (Teletypewriter) EE-97 and EE-98, and Teletypewriter Sets EE-97-A, EE-98-A, and EE-102.

a. ADJUSTING LINE CURRENT. (1) Determine the station which is to be the control station and which will supply line current.

(2) Thereafter, procedures at the two stations are as follows:

Control station

(a) Sets right-hand toggle switch of line unit at LOCAL CURRENT SUPPLY and LINE RHEOSTAT at IN.

(b) Adjusts line current to 75 ma by turning LINE RHEOSTAT in clockwise direction.

(c) Sends three 3-second break signals.

(d) When space-bar signals are received, adjust line relay (*b* below). When finished with line relay adjustment, sends one break signal, then space-bar signals, so that noncontrol station can adjust its line relay.

(3) If, during the adjustment of line current, it is not possible to obtain a meter indication of 60 ma, increase the current by the following procedure:

Control station

(a) Sends two 3-second break signals.

(b) Readjusts line current to about 60 ma.

Noncontrol station

(a) Sets right-hand toggle switch of line unit at DISTANT CURRENT SUPPLY and LINE RHEOSTAT at OUT.

(b) When meter indicates line current, keeps it below 90 ma and watches for signals from control station. Upon receipt of break signals, adjusts line current to 60 ma; then sends space-bar signals.

(c) Adjusts line relay, in accordance with instructions in *b* below; then sends one 3-second break signal to indicate completion of line relay adjustment.

Noncontrol station

(a) Meter indicates two 3-second break signals (zero current on the meter). Places LINE RHEOSTAT knob all the way counterclockwise (IN).

(b) Throws right-hand toggle switch to LOCAL CURRENT SUPPLY; then turns LINE RHEOSTAT knob clockwise for a reading of 70 ma. If line current decreases when right-hand toggle switch is thrown, reverses line unit power cord in the power source socket.

Note. Try to obtain a line current of about 60 ma for efficient operation. This is not always possible. However, follow the relay adjustment (*b* below), because

it is often possible to obtain operation on a limited basis with lint currents as low as 30 or 35 ma.

b. ADJUSTING LINE RELAYS.

(1) *General.* After line current has been adjusted, and upon receipt of repeated space-bar signals from the distant terminal, the operator at any station adjusts the line relay in accordance with instructions in the following subparagraphs. Before starting the adjustment, he checks to see that the left-hand toggle switch is at RELAY IN CIRCUIT.

(2) *Differing methods.* Because Bias Meter I-97-A is used to adjust the line relay satisfactorily in Line Unit BE-77 and because in Line Units BE-77-A and BE-77-B, circuits for this purpose are built into the units, methods of adjusting relays in the models differ and are given separately.

Caution: Be certain that only space-bar signals are being received before holding the key of the line unit in the BIAS position.

(a) *Line Units BE-77-A and BE-77-B.*

1. Hold the METER key in BIAS position (to the right).
2. Adjust the relay knob until the vibrations of the meter needle center on the zero mark of the meter scale (zero bias).
3. Release the METER key.
4. Send a break signal and complete the line-up as instructed in paragraph 24.

(b) *Line Unit BE-77 with Bias Meter I-97-A.*

1. Remove the bias meter adapter plug from the bias meter.
2. Remove the line relay from the line unit and place it in the socket provided for it in the bias meter.
3. Plug the bias meter adapter plug into the line unit relay socket and connect the bias meter power cord to the 115-volt d-c source. Measure the bias and adjust the relay as outlined in (a) above, depressing the button of the bias meter to read bias.
4. When the line-up is completed (par. 24), throw the left-hand toggle switch of the line relay to RELAY OUT OF CIRCUIT, disconnect the bias meter, and return the line relay to its socket in the line unit; then throw the left-hand toggle switch of the line unit to RELAY IN CIRCUIT.

(c) *Line Unit BE-77 Without Bias Meter I-97-A.* This method of adjustment is not as satisfactory as that performed when the bias meter is used, and may have to be supplemented by fine adjustment when test traffic is being received. The steps are as follows:

1. As space-bar signals are being received, turn the relay adjusting knob counterclockwise until garbled reception is observed.
2. Turn the knob clockwise, counting the turns until garbled reception is again observed.

3. Now turn the knob counterclockwise one-half the number of turns counted in 2 above.
4. Send a break signal and complete the circuit line-up as described in paragraph 24.

24. Completing Circuit-Line-Up

a. When a 3-second break signal is sent preliminary to completion of the relay adjustment procedures, transmission from the distant terminal ceases. The control station starts sending repeated space-bar signals so that the line relay at the distant terminal can be adjusted. When the distant terminal has completed adjustment of the line relay, it sends a second 3-second break signal.

b. Now test traffic. Receipt of accurate copy at both ends indicates that the line-up is correct and that the circuit is ready to handle traffic.

c. On very short lines it may not be possible to adjust the line relay for zero bias. However, satisfactory operation is possible in such cases. In other cases, the most common cause of failure to obtain proper operation is a poor line condition due to bad splices, damaged insulation, or poor ground connections.

25. Line-Up with Telegraph Central Office Set TC-3

a. The operator at Telegraph Central Office Set TC-3 is the control operator.

b. Before the line-up is started, operators agree upon a prearranged system of break signals.

c. Positive line battery is supplied by the control station. If the circuit is long enough to require battery supplied at both ends, negative battery is supplied by the noncontrol station.

d. The general procedure is to connect the line, adjust the line current, adjust the switchboard line relay for zero bias, and then adjust the distant station line relay for zero bias. When connections and preliminary adjustments have been made, operators follow the procedure outlined below to line up the circuit:

Control station

(1) Adjusts line rheostat for 75 ma.

(2) Sends three 3-second break signals.

(3) Patches BIAS METER jack to lower line jack of line being adjusted and operates METER key to BIAS position.

Noncontrol station

(1) Upon receipt of three 3-second break signals, proceeds to adjust line current as close as possible to 60 ma.

(2) Sends repeated space-bar signals.

(3) Upon receipt of break signal, releases space bar.

Control station

(4) Adjusts associated switch-board line, relay being adjusted until bias meter indicates one scale division to the left of zero on the bias meter.

(5) Puts METER key to LINE CURRENT position.

(6) Removes bias meter patching cord; sends break signal to interrupt transmission from noncontrol station.

(7) Sends repeated space signals by depressing space bar on teletypewriter.

(8) Releases space bar and sends one line of the letters *R* and *Y* alternately as test copy.

(9) Correct copy should be received. Operator restores METER key to VOLTAGE position and is ready to send messages.

Note. If incorrect copy is received after operation 5 by noncontrol station, there is trouble in the circuit which cannot be corrected by adjustment of line current and line relays, and the services of maintenance personnel are necessary.

Noncontrol station

(4) Adjusts line relay. When line relay adjustment is complete, sends break signal.

(5) Immediately repeats test copy.

26. Line-Up Procedure with Repeater Set TC-18 (Terminal, Telegraph)

a. For local operation of Reperforator Teletypewriter Set TC-16 and TC-17 with Repeater Set TC-18 in a circuit, power for the local circuit is furnished through the line units. The line unit power cord is connected to the rectifier used with the line unit to furnish negative 115 volts to the LINE terminal connected to Repeater TG-30, major component of the repeater set.

b. Upon signal from the repeater operator, operators at Reperforator Teletypewriter Set TC-16 or TC-17 set LINE RHEOSTATS at IN and right-hand toggle switches at LOCAL CURRENT SUPPLY.

c. Line current is then adjusted by the teletypewriter operators at 60 ma. Line current adjustment having been completed, line relays at either end of the circuit are then adjusted for zero bias.

27. Line-Up Procedure with Telegraph Terminal CF-2-(*) or Telegraph Terminal TH-1/TCC-1 Equipment

a. In a line-up of circuits in which Reperforator Teletypewriter Set TC-16 or TC-17 and Telegraph Terminal CF-2-(*) or Telegraph

Terminal TH-1/TCC-1 equipment is used, operators at the carrier terminals first make adjustments necessary on the line between terminals. Then they inform operators at the teletypewriters equipped with Line Unit BE-77-(*) next adjacent to them that the circuit is ready for line-up.

b. If the circuit is a metallic return circuit, and the carrier terminal bays are supplying ample current, operators at the line units throw the right-hand toggle switches to DISTANT CURRENT SUPPLY. If the circuit is a ground return circuit, or if the resistance on the loop circuit from the terminal to the teletypewriter is so high that in adjusting line current it is difficult to obtain an adjustment to 60 ma, line unit operators place the right-hand toggle switches to LOCAL CURRENT SUPPLY and thus increase the current.

c. Once the circuit is continuous from teletypewriter to teletypewriter, and operators at the teletypewriters have been notified by carrier terminal attendants, the operators at the line units proceed to adjust line current to 60 ma.

d. When line current has been adjusted, attendants at the carrier terminals and operators at the line units proceed to adjust for zero bias. Terminal attendants make their adjustments first by means of the bias adjusting mechanism in the terminals. As they make their adjustments, they may call the line unit operators several times for transmission of space-bar signals. When carrier bias adjustments have been made, carrier terminal attendants advise operators at line units to adjust the line relays for zero bias. When this is complete, the line is ready to test traffic.

28. Summary of Instructions for Placing Set in Service

- a. Set up equipment as described in paragraph 13.
- b. Check voltage and frequency of power sources.
- c. Set power-selector switch of reperforator transmitter and other teletypewriter equipment to match power source.
- d. If rectifiers are used, set transformer taps to match power source (TM 11-957).
- e. Set line unit switches for LOCAL or DISTANT CURRENT SUPPLY and RELAY IN or RELAY OUT OF CIRCUIT as required.
- f. Set LINE RHEOSTAT of line unit in extreme counterclockwise position.
- g. Connect power cords of rectifiers, line units, reperforator transmitter, and associated teletypewriters to proper power sources.
- h. Check ground connection and make ground connection to GND binding post of line units.
- i. Make a separate ground connection for the reperforator transmitter.

j. Make line connection to LINE binding posts on line units. If more than one line is used, connect additional lines to separate line units.

k. Make connections of SEND and REC cords LINE 1 from jack box to PRINTER jacks of line unit. If two line units are used, connect LINE 2 cords from jack box to PRINTER jacks of second line unit (fig. 20).

l. Start and check all teletypewriter motors and check functioning of machines on local circuits.

m. Check d-c voltages by line unit meters and adjust voltages if necessary while motors are running.

n. Take reperforator cords from local circuit 1 of jack box and insert them in designated jacks of line 1 on jack box.

o. Adjust line relays for zero bias.

p. Insert reperforator cords in jacks of line 2 and adjust line relays for zero bias.

q. Connect signal circuit cords of reperforator, transmitter distributor, and associated teletypewriters for operating combinations desired.

r. Proceed to line-up of line circuits with other equipment.

29. Procedure for Removing Units from Service

a. Shut off the power.

b. Disconnect all power-cord and signal-circuit connections.

c. Replace all parts in their respective carrying cases.

d. Fold the line, power, reperforator, and transmitter distributor cords of the reperforator transmitter carefully in the space between the jack box and rear of the reperforator.

e. Fasten the free ends of the signal cords by plugging them into jacks of the jack box.

f. Place the free ends of the power cords under the hinged cord retainer on the base to the rear of the transmitter distributor.

g. Check that the tape trap doors in both the base and cover are closed before placing the cover over the base.

Section VI. OPERATION

30. Starting and Stopping Reperforator and Transmitter Distributor

a. The motor switch of the reperforator must be at ON to have the motor running and in readiness to receive or transmit messages. A distant station cannot start and stop the reperforator motor as in the case of page-printing teletypewriters. When the platen is in the figures position, operation of the H key on the reperforator will stop the motor of associated teletypewriters equipped with mechanical motor control.

b. With the transmitter distributor motor running, transmission from tape may be started or stopped by means of the STOP-SEND switch on the front of the unit base.

c. The LINE-BREAK key is mounted to the left of the reperforator keyboard and when it is desired to send a break signal, this key must be depressed and held down for at least 1 second.

31. Operation of the Reperforator Keyboard

The keys should be struck with firm, evenly spaced strokes. When the end-of-line signal lamp (fig. 2) lights, or when it is desired to start a new line on an associated page teletypewriter, depress the LTRS, CAR RET, and LINE-FEED keys in succession. To send a single space, as between words, depress the space bar completely and release it immediately. Spaces will be sent as long as the space bar is held depressed. When it is desired to send lower case letters, depress the LTRS key and then strike the keys for the desired letters. To send figures, punctuation marks, and other characters, symbols, or functions marked on the key tops above the letters, depress the FIGS key and then the keys for the desired figures or characters. Remember that the reperforator shifts back to print letters after operation of the space bar, as well as after operation of the LTRS key. Use the BELL key to signal or attract the attention of the distant station operator.

32. Emergency Operation

a. Occasionally trouble arises when a relay of the line unit becomes damaged or is found to be defective. When trouble of this kind occurs and a replacement for the defective relay is not at hand, it is sometimes possible to obtain satisfactory operation over short lines by throwing the left-hand toggle switch in the line unit to RELAY OUT OF CIRCUIT. Recheck the line current to be sure that it is between 60 and 65 ma. Line current may be supplied if it is desirable.

b. When a suitable source of d-c is not available, it is sometimes possible to obtain satisfactory operation over short lines by throwing the line unit toggle switches to RELAY OUT OF CIRCUIT and DISTANT CURRENT SUPPLY positions. However, the line current should be rechecked to be certain that it is between 60 and 65 milliamperes.

33. Operation Under Adverse Climatic Conditions

a. Operation and maintenance of teletypewriter equipment in arctic, tropical, or desert regions involve a number of problems peculiar to these regions. Moisture condensation resulting from extreme humidity or rapid temperature changes causes short circuits and crossfire. Deterioration of parts due to rust and corrosion may lead to complete break-down of the equipment. Entry of dirt, dust, or sand encountered in desert regions will affect operation and may lead to break-down.

b. Guard against corrosion by keeping the equipment as dry as possible. In extremely cold regions install the equipment in a heated inclosure. Whenever possible, make sure ground rods are driven below the frost line to insure good ground contact.

c. Appendix II furnishes a list of Technical Bulletins on maintenance of equipment under adverse climatic conditions.

Section VII. OPERATOR ROUTINE CHECKS OF PERFORMANCE

34. Periodic Line-Up Procedure

At intervals, the frequency of which can best be decided by the operator of the equipment, there should be periodic line-ups of the equipment to check that it is operating as it did when it was initially lined up. These periodic line-ups can follow the sequences described in paragraphs 19 to 27, inclusive. The frequency of such periodic line-ups will be governed by such factors as how intensively the system is used, in what type of atmosphere it is used, whether the installation is temporary, semi-permanent or permanent, and a number of other factors.

35. Station Records for Operation

a. Record cards should be kept on all equipment, but one card may include an entire set such as Reperforator Teletypewriter Set TC-16 or TC-17, etc. It is important that all equipment cards be kept up to date at all times. If trouble is reported on some particular equipment, it is a matter of only a few minutes to look up the record of that equipment. Usually any trouble encountered in teletypewriter equipment may be traceable to something that happened in the past. If a particular piece of equipment is constantly giving trouble, the record card will show it and the equipment may be removed from service and given a thorough overhauling.

b. Normally, teletypewriter circuits are tested every day by operating personnel. Any trouble found during these tests or at any other time is reported to the person in charge of maintaining the teletypewriter equipment. To expedite the handling of reports of teletypewriter troubles and requests for rearrangement or moves, an instruction card may be fastened to the lower left-hand corner of the copy holder of each teletypewriter. Remember that a card not kept up to date is worse than no card at all. Such a card as this generally states the equipment designation, and who to call in case of trouble, with instructions that when the authorized person is called, the machine designation, plus as much information as possible as to how the trouble is affecting the machine, be given. Figure 29 is a recommended instruction card lay-out.

c. In a teletypewriter central where a large amount of equipment is involved, it may be necessary to keep records and schedules of the periodic

This Teletypewriter Set is Designated as:
Reperforator Teletypewriter Set TC-16, No. 16

In Case of Trouble Call:

Beaver II

and give machine designation, plus as
much information as possible as to
how the trouble is affecting the
machine.

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Figure 29. Recommended instruction card lay-out.

routines and tests of the equipment. This insures that each piece of equipment is checked and serviced when it should be and prevents many future troubles. A basic routine schedule, when properly prepared, shows all routine procedures essential in maintaining the equipment to which the schedule specifically applies. The frequency at which the routines are to be performed should also be indicated. Figure 30 is a recommended lay-out of a routine schedule for Reperforator Teletypewriter Sets TC-16 and TC-17.

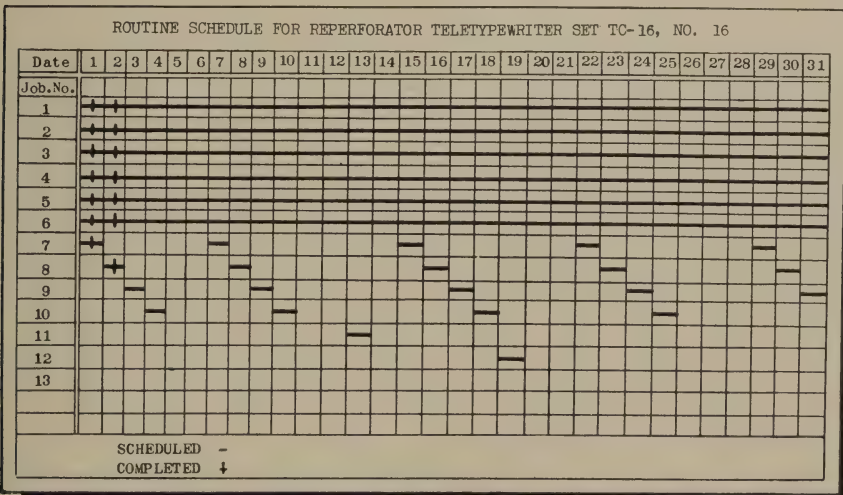
d. Each job in the routine schedule is given a number to facilitate servicing. For example, the maintenance man may be instructed to perform job No. 11 on Reperforator Teletypewriter Set TC-16, No. 16, which is shown on the routine schedule as fuse and fuse indicator inspection. The routine schedule should be posted for all operating and maintenance personnel to refer to when performing the various jobs. The frequency at which the jobs should be performed will not necessarily be as shown in figure 30, but will vary according to location, weather conditions, etc. For example, weather conditions may cause line current to fluctuate, necessitating shorter intervals between circuit line-ups. Normally, all jobs must be performed at shorter intervals when the equipment is used in tropical climates. Figure 31 shows a typical lay-out for a

ROUTINE SCHEDULE FOR REPERFORATOR TELETYPEWRITER SET TC-16, NO. 16

Item	Job No.	Frequency
Clean machine and associated equip.....	1	Daily
Check motor speed.....	2	Daily
Inspect ribbon.....	3	Daily
Check rectifier output.....	4	Daily
Check line current.....	5	Daily
Check bias adj.....	6	Daily
Clean line plugs.....	7	Weekly
Inspect for bent plugs, frayed cords, etc.....	8	Weekly
Test, clean, lubricate machine.....	9	Weekly
Check signal lamp.....	10.....	Daily
Inspect fuses and blown fuse indicators.....	11.....	Monthly
Clean, adj. 41-C relay.....	12.....	Monthly
Calibrate bias meter.....	13.....	Seri-Annually

TL 57618S

Figure 30. Recommended lay-out of routine schedule for Reperforator Teletypewriter Sets TC-16 and TC-17.



TL 57617S

Figure 31. Recommended lay-out for job schedule.

job schedule. Such a schedule should be posted for 1 calendar month. A horizontal line is drawn through the square representing the job number and the day it is to be performed; when the work is completed a vertical line is drawn in the square. For example, job No. 7, which is cleaning the line plugs according to the routine schedule (fig. 30), is performed weekly. It is shown in figure 31 as being scheduled and performed on the 1st of the month and is scheduled to be performed on the 8th, 15th, 22d, and 29th days. The figure also shows that all work scheduled for the first and second days of the month has been completed.

36. Purpose and Use of Equipment Performance Check List

a. GENERAL. The equipment performance check list (par. 37) will help the operator determine whether Reperforator Teletypewriter Set TC-16 or TC-17 is functioning properly. The check list gives the item to be checked, the condition under which the item is checked, the normal indications of correct operation, and corrective measures that the operator can take.

b. ACTION OR CONDITION. For some items the information given in the action or condition column consists of settings of various switches and controls under which the items are to be checked. For other items it represents an action that must be taken to check the normal indication given in the normal indication column.

c. NORMAL INDICATIONS. The normal indications listed include the visible and audible signs that the operator will find when he checks the items. In meter readings, the allowable tolerances for the readings are given. When a meter reads between the limits specified, operation can be considered satisfactory. A meter reading outside the limits given is a sign of impending trouble. If the indications are not normal, the operator should apply the recommended corrective measures.

d. CORRECTIVE MEASURES. When normal indications are not present, the operator can perform the corrective measures listed without turning the equipment in for repairs. If the set is completely inoperative or if the recommended corrective measures do not yield results, the set should be turned over to a teletypewriter mechanic as soon as possible. If the situation requires that service be maintained and if the set is not completely inoperative, the operator must maintain the set in operation as long as it is possible to do so.

37. Equipment Performance Check List for Reperforator Teletypewriter Set TC-16

Item No.	Item	Action or condition	Normal indication	Corrective measures
1	Grounds.	Low-resistance ground connected to GND binding post of line unit or units, if more than one line unit is used. Make separate ground connection for reperforator transmitter.		
2	Power sources.	Voltage and frequency have been determined. Power cords of rectifier, line unit or line units, reperforator transmitter, and associated teletypewriters connected to proper power sources.		
3	Power selector switches.	Set to match power sources. Be sure setscrews are tightened securely.		
4	Rectifier.	Transformer taps set to match power sources (TM 11-957).		
5	Line unit rheostat.	Turned counterclockwise as far as it will go (all resistance in).		
6	Line unit binding posts.	Short line and ground to set up local circuit.		
7	Line unit switches.	Set for LOCAL CURRENT supply, RELAY OUT OF CIRCUIT.		

PREPARATORY

37. Equipment Performance Check List for Reperforator Teletypewriter Set TC-16—Continued.

Item No.	Item	Action or condition	Normal indication	Corrective measures
8	Jack box.	SEND and REC cords of LINE 1 connected from jack box to PRINTER jacks of line unit. If two line units are used, LINE 2 cords are connected to PRINTER jacks of second line unit.		
9	Motor switches.	Turn to ON on reperforator transmitter and page teletypewriter, if one is used.	All motors should start.	If any motor fails to start, refer to TM 11-2223 and TM 11-352.
10	METER key of line unit.	Check voltage of power source with motors running.	Meter should indicate 115 volts.	If it does not, check rectifier taps.
11	Local cording circuit test.	Place reperforator and transmitter distributor cords in local circuit 1 on jack box.		
12	Keyboard.	Send test copy. Feed punched tape to test transmitter distributor.	Reperforator repeats tape sent to transmitter distributor.	
13	Line test.	Remove short from line unit. Remove reperforator cords from local circuit 1 of jack box and insert them in designated jacks for line 1 on jack box.		

START

14	Line unit switches.	Set for RELAY IN CIRCUIT, DISTANT CURRENT SUPPLY.		
15	Line rheostat of line unit.	Adjust line current in each line.	Meter should indicate 60 ma.	
16	METER key of line unit.	Check voltage of power source by putting key at VOLTS, and test bias by placing key at BIAS.	Meter should indicate 115 volts in voltage test and 0 bias in bias test.	If indication is not 115 volts, check rectifier taps. If bias indication is not zero, adjust line relay.
17	Keyboard.	Operate to see that tape feeds properly when space bar is depressed. Send copy to see that end-of-line indicator lamp lights on 62d to 66th character.		If lamp does not light, check bulb.
18	Manual tape feed out.	See that tape feeds properly.	Tape should feed off tape holder in one way only.	
19	Stopping machines.	Turn motors to OFF.		

CHAPTER 3

MAINTENANCE INSTRUCTIONS

Section VIII. PREVENTIVE MAINTENANCE

38. General

a. This section covers only the maintenance work that can be done by the operating personnel. Lubrication and adjustment of the units of Reperforator Teletypewriter Sets TC-16 and TC-17 which need lubrication and adjustment and the clearing of mechanical and circuit troubles can be done properly only by technically trained maintenance personnel. Detailed information on the latter type of maintenance is not included in this technical manual but appears in technical manuals covering the various units which make up these teletypewriter sets.

b. Routine inspections should be made at regular intervals to keep the equipment clean and to keep loose ends of tape and other pieces of paper from the floor and all operating positions. The surfaces of all tables and apparatus should be dusted periodically.

c. The teletypewriter operator and installer should be prepared to perform preventive maintenance. This means maintenance which can be accomplished without use of special tools or special technical knowledge. It includes checking equipment, dusting equipment, making minor adjustments, and reporting damaged or faulty equipment. If, at any time, a teletypewriter is out of order and the operator is unable to correct the trouble, the operator must call a maintenance man *at once* and notify the net control station of the difficulty. When the equipment is again in operation, the station operator should notify the message center chief of the fact.

39. Care of Reperforator

If the following maintenance procedures are followed by the operator, he will aid greatly in keeping the machine in proper operating condition:

a. DUSTING. Keep the machines free from dust. Regularly dust all parts of the machine which can be reached without removing the cover.

b. CLEANING. Clean the key caps with a cloth moistened with water. *Do not use alcohol as a cleaning fluid.*

c. TIGHTENING LOOSE NUTS AND SCREWS. Tighten all nuts and screws that become loose. However, do not remove the cover or disassemble the equipment to perform this type of maintenance.

d. INSERTION OF PAPER. Insert a new tape roll in the reperforator when the old roll becomes used up. Instructions for doing this are given in paragraph 40.

e. ANALYSIS OF TROUBLE. If the machine does not operate properly, the operator should try to locate the source of the trouble by performing checks outlined in technical manuals covering the various units which go to make up these teletypewriter sets.

f. TAMPERING WITH UNITS. If the units fail to operate, or begin to operate improperly, and the trouble cannot be located by the operator, he should summon a maintenance man at once.

40. Changing Tape on Reperforator

When it is necessary to place a new roll of tape on a reperforator, proceed as follows:

a. Tear the old roll of tape near the right-hand end of the tape chute.

b. Remove the piece of tape remaining in the reperforator by removing the reperforator cord from its jack long enough for the reperforator to space the tape out.

c. Remove the tape retainer and the used tape roll.

d. Place the new roll of tape in the tape reel container so that the tape unwinds from the bottom and toward the front of the reperforator. Be sure tape out lever is free and on the outside of the roll. Replace the retainer.

e. Pass the tape over the tape tension spring roller, under the tape guide or reperforator cover, through the tape chute and punch block, and between the feed roll and tape tension lever.

f. While the reperforator cord is removed from its jack, exert a slight pressure on the tape tension lever, until the tape is feeding out evenly.

g. Clean off any lint and dust that has accumulated around the tape chute, punch block, and feed roll.

41. Replacing Reperforator Ribbon

a. Replace the ribbon before the printing becomes light.

b. To change the ribbon, remove both ribbon spools and the worn ribbon from the reperforator. Unwind the tape from one of the spools and attach one end of the new ribbon to this spool. Replace both spools on the ribbon spool shafts with the ribbon unwinding from the bottom of both spools, passing over the ribbon rollers, through the slots in the ribbon reverse arm, and under the center loop of the ribbon guide.

42. Other Maintenance Information

a. For lubrication and adjustment of the typing reperforator, see TM 11-2223, and for lubrication and adjustment of the transmitter distributor, see TM 11-2222.

b. For adjustment of polar relays, using Test Set I-193-A, see TM 11-2513.

c. For complete schematic and wiring diagrams of the major equipment components of Reperforator Teletypewriter Sets TC-16 and TC-17, see Technical Manuals covering those components.

d. Preventive maintenance check lists covering the various units of Reperforator Teletypewriter Sets TC-16 and TC-17 are given in the Technical Manuals on the units.

Section IX. LUBRICATION

43. Applicable Instructions

Instructions for lubrication of the components of Reperforator Teletypewriter Sets TC-16 and TC-17 appear in technical manuals covering those components, in TM 11-2222 for the transmitter distributor, in TM 11-2223 for the typing reperforator, and in TM 11-957 for the rectifier. Line Unit BE-77-(*) requires no lubrication.

Section X. WEATHERPROOFING OF EQUIPMENT

44. General

Moistureproofing and fungiproofing instructions for various units which make up Reperforator Teletypewriter Sets TC-16 and TC-17, with the exception of the jack box on the reperforator, appear in Technical Manuals covering those units, so that in this manual only the instructions for moistureproofing and fungiproofing the jack box are given.

45. Moistureproofing and Fungiproofing Reperforator Connection Box

a. PREPARATION. Make all repairs and adjustments necessary for proper operation of the equipment.

b. DISASSEMBLY. (1) Remove the connection box from the carrying case base.

(2) Remove the cover plate, fuses, and plugs from the jacks.

(3) Do not disconnect any of the wiring inside the box.

c. CLEANING. Clean all dirt, dust, rust, fungus, oil, grease, etc., from the connection box.

d. MASKING. If the coating is to be brushed on, it will not be necessary to mask any of the parts. Be careful that the coating material does not drip or run on the contact surfaces of the switches and jacks. If the coating material is to be sprayed on, mask the following parts:

(1) Jack spring contacts and sleeves.

(2) Fuse socket contacts.

(3) Switch openings.

e. DRYING. Place the connection box in a drying oven or under heat lamps and dry for 2 to 3 hours at 160° F.

f. VARNISHING. Apply three coats of Lacquer, Fungus-resistant, Spec. No. 71-2202 (stock No. 6G1005-3), or equal, to all wiring, coils, capacitors, resistors, terminal blocks and strips, jack pile-up insulators, and all unpainted or unvarnished metallic surfaces that support the circuit elements. Do not apply the coating to the bodies of the two large resistors in the power circuit. Rubber-covered cables and painted or varnished surfaces need not be coated.

g. REASSEMBLY. After the lacquer is dry, remove the masking tape on units that have been sprayed, remount the connection box on the carrying case base, and replace all fuses and plugs that were removed. Replace the cover plate. Test the connection box for proper operation.

h. MARKING. Mark the connection box with MFP and the date of treatment to show that it has been moistureproofed and fungiproofed.

Example: MFP—17 Sep 46.

46. Moistureproofing and Fungiproofing After Repairs

If the coating of protective varnish has been punctured or broken during repair, and if complete treatment is not needed to reseal the equipment, brush-coat the affected part. Be sure the break is completely sealed.

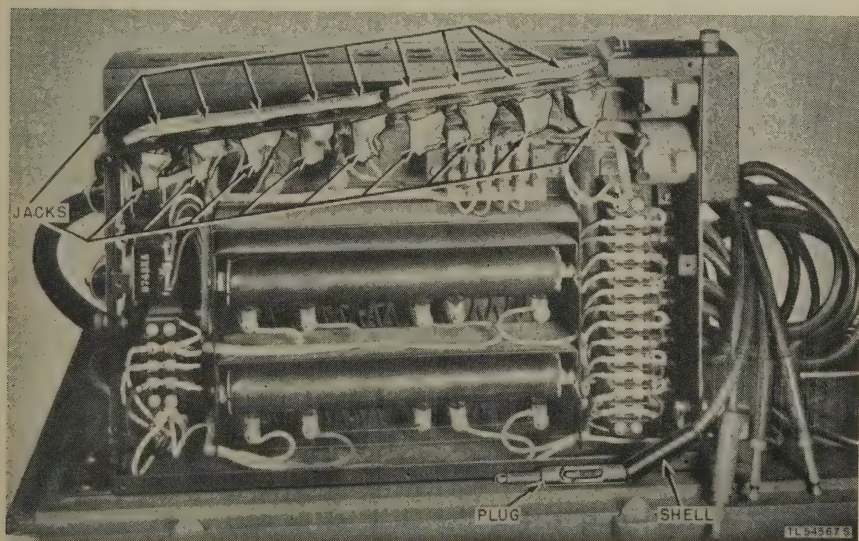


Figure 32. Jack or connection box masked for moistureproofing and fungiproofing.

CHAPTER 4

AUXILIARY EQUIPMENT

Section XI. REPEATER TG-30 (TERMINAL) AND TELEGRAPH TERMINAL TH-1/TCC-1

47. Repeater TG-30 (Terminal)

a. This repeater (fig. 33) is used to make connections from a polarential or two-part polar line circuit to a neutral type local circuit, such as is used in Switchboard BD-100, Line Unit BE-77-A, Telegraph Terminal CF-2-A or -B, Telegraph Terminal CF-6, and Telegraph Terminal TH-1/TCC-1. The polarential or two-path polar line side may extend to another Repeater TG-30 (Terminal) or similar polarential or two-path polar termination such as furnished in carrier telegraph terminals.

b. Repeater TG-30 (Terminal) is commonly used for point-to-point teletypewriter circuits on long field wire lines with or without an intermediate repeater. The two-path polar line operating feature is intended primarily for operating to British terminal units. The local sides of two Repeaters TG-30 may be connected for intermediate operation and, if required, a teletypewriter may be used in the local circuit for sending and receiving, but the connection between the repeater and teletypewriter should be limited to the length of the teletypewriter cords. The repeater operates on 115 or 230 volts, 50- to 60-cycle alternating current or on a nongrounded source of 115 volts direct current, such as is supplied by a gasoline-engine-driven power unit. A-c power is converted to d-c by a built-in rectifier. Repeater TG-30 provides half-duplex service only. A manual telegraph set using an oscillating circuit with an adjustable tone is built into the equipment, and a telephone headset is supplied. TM 11-2004 covers Repeater TG-30 (Terminal) in detail.

48. Telegraph Terminal TH-1/TCC-1

a. Telegraph Terminal TH-1/TCC-1 (fig. 34) is designed to provide two-way voice-frequency carrier telegraph communication by utilizing a portion of the frequency range (about 1,500 to 2,000 cycles) of a voice-frequency telephone circuit. The facilities required for this dual service, known as speech plus duplex, do not, in general, differ from the requirements for a satisfactory voice-frequency telephone circuit obtained from wire or carrier facilities. Telegraph Terminal TH-1/TCC-1 is used principally at terminals of telephone and telegraph circuits and at inter-



Figure 33. Repeater TG-30 (Terminal).

mediate points where a telephone circuit extends through but the telegraph circuit terminates or transfers to other circuits.

b. Telegraph Terminal TH-1/TCC-1 will normally provide a satisfactory transmission medium for teletypewriter signals up to 66 words per minute over any line the attenuation of which does not exceed 50 db. Telegraph Terminal TH-1/TCC-1 can be operated in connection with other d-c loop or extension circuits either on a full-duplex or half-duplex basis, full-duplex providing for the simultaneous transmission of telegraph signals from each end and half-duplex providing for the transmission of only one message at a time from either end. Switching arrangements permit operating the terminal with any of the following full-duplex and half-duplex services over the telegraph loops: half-duplex, neutral to positive battery operation; full-duplex, neutral to positive battery operation; half-duplex, neutral to negative battery operation; full-duplex, neutral to negative battery operation; polarizational half-duplex operation;

two-path polar operation; and half-duplex neutral operation with no line battery at outlying point.

c. TM 11-2206 covers Telegraph Terminal TH-1/TCC-1 completely.

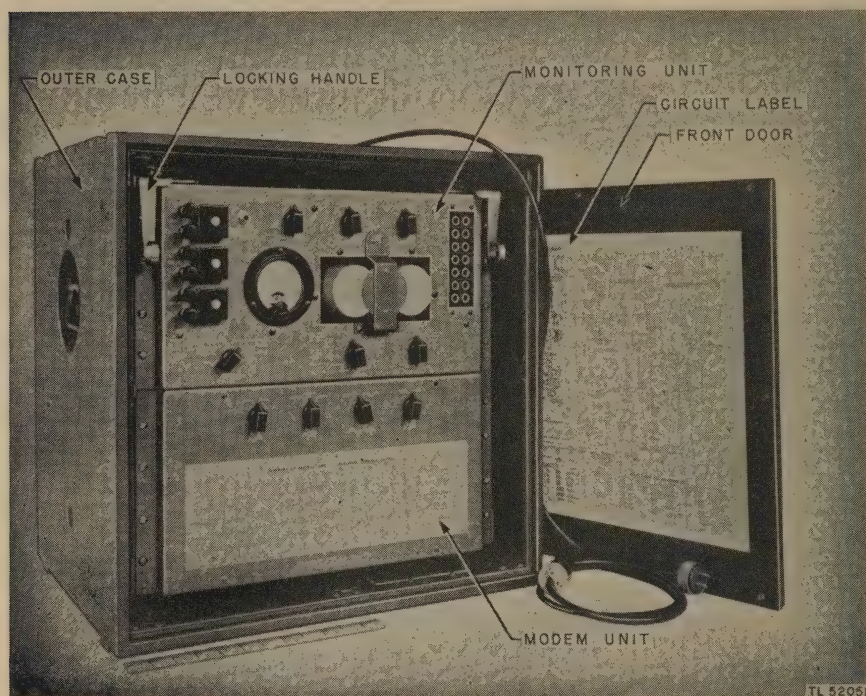


Figure 34. Telegraph Terminal TH-1/TCC-1, front view.

CHAPTER 5

REPAIR INSTRUCTIONS

Section XII. GENERAL REPAIR PROCEDURES

49. Repair Techniques

The decision to make repairs or to turn equipment in for replacement must be based on complete knowledge of the construction and operation of the various parts and circuits of the equipment. Service failures can be kept to a minimum by careful handling of the equipment during installation and by a completion of the preventive maintenance procedures outlined in Technical Manuals covering the units that make up Reperforator Teletypewriter Sets TC-16 and TC-17. When service faults are discovered, follow a definite plan of corrective maintenance in order to reduce both the time the equipment is in trouble and the time required to complete repairs.

50. Unsatisfactory Equipment Report

a. WD AGO FORM 468 (WAR DEPARTMENT UNSATISFACTORY EQUIPMENT REPORT) FOR EQUIPMENT USED BY ARMY GROUND FORCES AND TECHNICAL SERVICES. WD AGO Form 468 will be filled out and forwarded through channels to the Office of the Chief Signal Officer, Washington 25, D.C., when trouble occurs more often than is normal, as determined by qualified repair personnel.

b. AAF FORM 54 (UNSATISFACTORY REPORT) FOR EQUIPMENT USED BY ARMY AIR FORCES. AAF Form 54 will be filled out and forwarded to Commanding General, Air Matériel Command, Wright Field, Dayton, Ohio, in accordance with AAF Regulation 15-54, when trouble occurs more often than is normal, as determined by qualified repair personnel.

Section XIII. TEST EQUIPMENT

51. Test Set TS-2/TG

Test Set TS-2/TG is used to test selector units and bias meters. This test set is used principally by tactical and fixed plant organizations. It provides a continuous source of the following neutral (open and close) test signals: letter R, letter Y, repeated space-bar signals, and a test message consisting of the phrase THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 TESTING fol-

lowed by a carriage return and a line feed. It can be arranged to transmit undistorted test signals, or test signals with a predetermined percentage of marking or spacing bias, or test signals with a predetermined percentage of marking or spacing end distortion. A 60-ma test circuit is built into the test set to provide a ready means for measuring the bias tolerances of teletypewriter receiving equipment. For detailed information on Test Set TS-2/TG, see TM 11-2208.

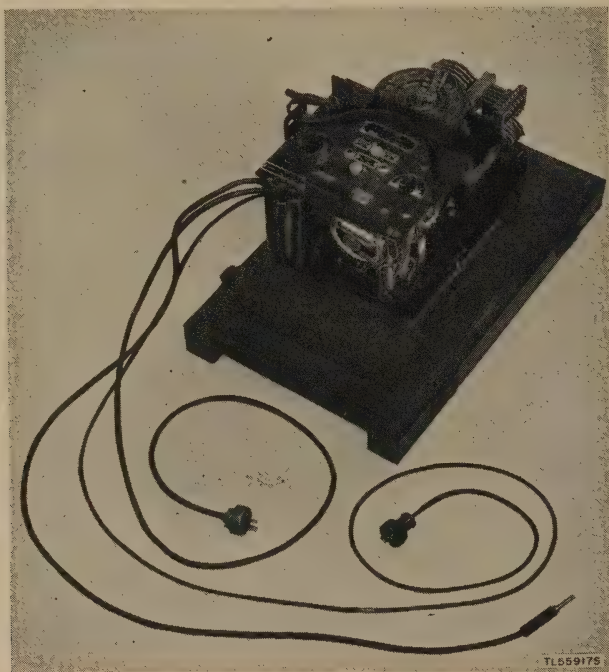


Figure 35. Test Set TS-2/TG, cover removed.

52. Distortion Test Set TS-383/GG

This test set is primarily for maintenance depot use. It contains, in general, the sending features of Test Set TS-2/TG, described in paragraph 51 but not the 60-ma local circuit. In addition, it contains a means for measuring distortion of signals by the use of a stroboscopic device. The set is arranged to use an a-c series governed motor and includes motor unit and gears. TM 11-2217 gives a detailed description of this test set and its uses.

53. Multimeter TS-380/U

This is a small portable instrument for the measurement of a-c voltage, d-c current, and resistance. It is designed particularly for maintenance

use with ground wire communications equipment, voice-frequency and carrier-frequency telephone and telegraph equipments, d-c telegraph equipment, portable operations centers, etc. For complete information on Multimeter TS-380/U, see TM 11-2042.

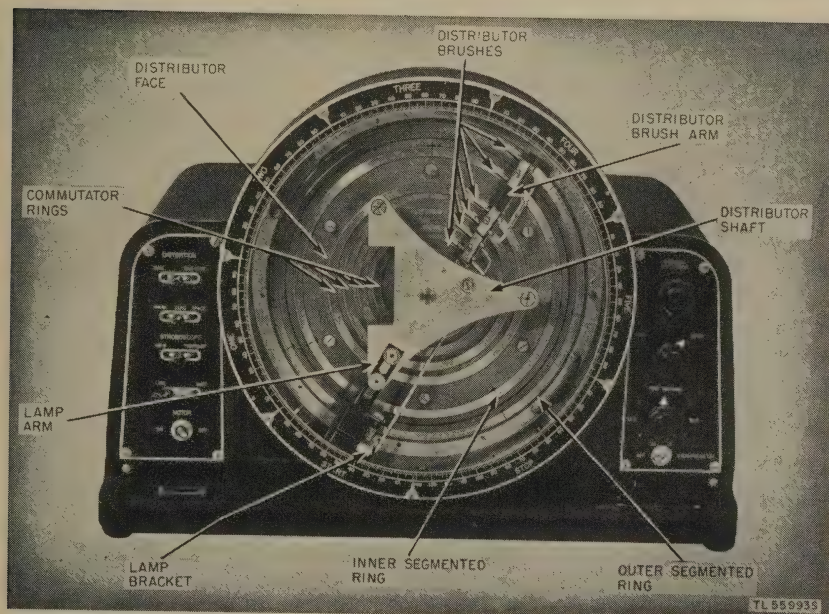


Figure 36. Distortion Test Set TS-383/GG.

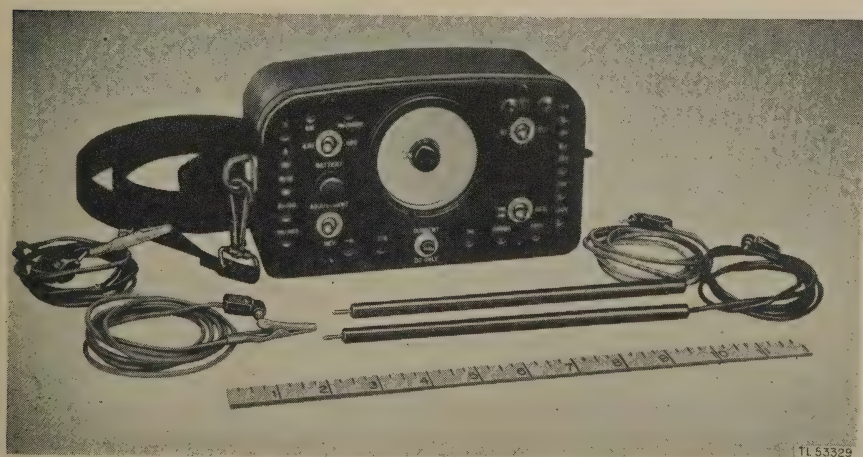


Figure 37. Multimeter TS-380/U.

Section XIV. TROUBLE SHOOTING

54. Introduction to Trouble Shooting

a. GENERAL. Thorough knowledge of the sequence of operation for each functioning element in the reperforator teletypewriter set is of fundamental importance in analyzing trouble. The trouble shooter must be able to prove quickly whether trouble is in a particular assembly or in other parts of the equipment. The appearance of a particular operating failure may immediately indicate the exact location of the faulty adjustment or the damage; if not, it will be necessary to determine with exactness those functions which are operating properly and those which are at fault.

b. PROCESS OF ELIMINATION. By determining which of the transmitting, receiving, and common functions of the equipment do and which do not operate properly, the trouble shooter has eliminated the possibility of wasting considerable time and effort. Trouble analysis charts are given in TM 11-2222 covering the transmitter distributor, and in TM 11-2223 covering the reperforator. TM 11-957 describes troubles and methods of detecting them in Rectifier RA-87, and TM 11-359 covers trouble shooting in Line Unit BE-77-(*). By sending to and receiving from a second reperforator teletypewriter set, the trouble is proved to be in either the transmitting, receiving, or common functions. A local or dummy testing circuit can also be used when a second set is not readily available.

c. LOCALIZING ELECTRICAL TROUBLE. Electrical circuits in the teletypewriter equipment are provided with connecting terminals where it will be necessary to connect or disconnect circuits or units. Do not disturb the wiring any more than is necessary in testing and inspection. The majority of electrical troubles will be found in relays, in connections or at contacts in switches and jacks, or where the insulation on wire between metal parts has been damaged. When necessary, use a milliammeter or voltohmmeter to prove the location of electrical troubles. Refer to schematic and wiring diagrams and charts, and make point-to-point tests until the fault is located.

d. LOCALIZING MECHANICAL TROUBLES. After a mechanical function has been observed either to fail to operate or to operate in a faulty manner, it is necessary to localize or isolate the circuit trouble in a particular adjustment or series of adjustments. Experience and the over-all condition of the equipment will indicate which of two methods is the better approach to various troubles. One method involves checking the individual requirement for all adjustments in the subassembly or mechanism. Use the related detailed requirements and adjustment procedures to determine the sequence to be followed. A second method involves setting up by hand the selecting mechanism and completing the operation by manually rotating the motor, shaft, gear, or cam that normally drives the assembly.

This method is usually the quicker when only one adjustment is faulty and the remainder of the mechanism is in good condition. In such cases only related adjustments need be checked.

Caution: In some cases evidences of faulty operation may be apparent only when the mechanism is power-driven.

55. Wiring and Schematic Diagrams

Wiring and schematic diagrams for the reperforator, the transmitter distributor, the rectifier, and the line unit appear in the Technical Manuals covering those equipments and can be of great assistance if referred to in connection with localizing electrical and mechanical troubles.

APPENDIX I

INTEROPERATION OF BRITISH AND AMERICAN TELETYPEWRITER SETS

1. Modifications Necessary

The teletypewriter mechanic in the field may be required to install American teletypewriter equipment to operate in conjunction with British teleprinter equipment. For this reason, it is necessary to be familiar with the British equipment and the modifications that must be made to permit interoperation of the two types. The basic difference between American and British equipment is that the American equipment normally operates on a neutral basis and the British equipment operates, normally, on a polar basis. Figure 38 shows a British field teleprinter with batteries and Mark IV terminal unit. The terminal unit corresponds somewhat to the American line unit.



Figure 38. British teleprinter with batteries and terminal unit Mark IV.

2. Differences Adjusted

Interoperation of the American teletypewriter equipment with the British teleprinter equipment can be accomplished with slight loss of efficiency

after certain differences in the two types of equipment are adjusted. Adjusting these differences by increasing the motor speed and decreasing the number of characters per line on the American machines and adding auxiliary line equipment to the British machines are problems for qualified maintenance personnel. The purpose of this manual is to cover the differences in the two systems only from the standpoint of the operator and installer.

3. Keyboard Differences

Several differences exist in the upper case sections of the American and British keyboards. Therefore, in general, only the numerals and punctuation symbols of the upper case sections of the keyboards should be used in an interoperation system. However, a few exceptions are described here.

a. British machines have no equivalent for our weather keyboard, so that Reperforator Teletypewriter Set TG-27-A cannot be used in a network with British machines.

b. The motors of the British machines start on an open or break signal. Motors of the American machines start on the close after an open or break has been received.

c. British operators may stop the American machines by sending the upper case H. The British machines have an automatic stop feature which causes the motor to stop after the circuit remains idle and closed for 1½ minutes.

d. The unshift-on-space feature present in the American machines is missing in British machines. Therefore, the American machines must be made to unshift on letters only. This is a job for qualified maintenance personnel and is described in TM 11-2223.

e. British machines are built so that one character is stored in the selector mechanism even after the operator on an American machine has pressed the key for this stored character. It is necessary for the operator of an American machine in an interrogation set-up to press once either the space bar or the LTRS or CAR RET key before the final letter in the particular word being transmitted is received by the operator of a British machine.

f. An answer-back feature is included in some types of British machines and, in a set-up of British machines, provides for a code answer from the distant machine when the *WHO-ARE-YOU* key is depressed. This feature is not provided on American machines and therefore in interoperation with British machines it is not used on the British machines.

g. Operating procedure requires that CAR RET, LINE FEED, and LTRS keys on both American and British machines be depressed twice at each end of the line by the sending operator.

					KEYBOARDS			
SIGNAL CODE					LOWER CASE		UPPER CASE	
1	2	3	4	5	AMERICAN	BRITISH	AMERICAN	BRITISH
					A	A	-	-
					B	B	?	?
					C	C	:	:
					D	D	\$	WHO ARE YOU (1)
					E	E	3	3
					F	F	!	%
					G	G	&	@
					H	H	STOP	£
					I	I	8	8
					J	J	/	BELL (2)
					K	K	((
					L	L))
					M	M	.	.
					N	N	,	,
					O	O	9	9
					P	P	Ø	0
					Q	Q		
					R	R	4	4
					S	S	BELL	/
					T	T	5	5
					U	U	7	7
					V	V	;	=
					W	W	2	2
					X	X	/	/
					Y	Y	6	6
					Z	Z	"	+
					LINE FEED	LINE FEED	LINE FEED	LINE FEED
					CAR. RET.	CAR. RET.	CAR. RET.	CAR. RET.
					FIGS.	FIGS.	FIGS.	FIGS.
					LTRS.	LTRS.	LTRS.	LTRS.
					SPACE	SPACE	SPACE	SPACE

(1) NOT USED ON BRITISH ARMY FIELD MACHINES, USED ON D.T.N. IN GREAT BRITAIN.

(2) NOT USED BY BRITISH ARMY.

TL- 50174

Figure 39. Differences in American and British keyboards.

APPENDIX II

REFERENCES, ABBREVIATIONS, AND GLOSSARY

1. References

Note. For availability of items listed, check FM 21-6 and WD Supply Catalog SIG 1 and 2. Also see FM 21-6 for applicable Technical Bulletins, Supply Bulletins, Modification Work Orders, and changes thereto.

a. PARTS LIST.

- SIG 1 and 2 Introduction and Index.
- SIG 3 List of Items for Troop Issue.
- SIG 4-1 Allowances of Expendable Supplies.
- SIG 4-2 Allowances of Expendable Supplies for Schools, Training Centers, and Boards.
- SIG 5 Stock List of All Items.
- SIG 6 Sets.
- SIG 7 Organizational Spare Parts.
- SIG 8 Higher Echelon Spare Parts.
- SIG 10 Fixed Plant Maintenance List.
- SB 11-76 Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment.

b. TECHNICAL MANUALS ON AUXILIARY EQUIPMENT AND TEST EQUIPMENT.

- TM 11-278 Radio Teletype Equipment AN/TRA-7.
- TM 11-354 Telegraph Printer Sets (Teletypewriter) EE-97 and EE-98, Teletypewriter Sets EE-97-A, EE-98-A, and EE-102.
- TM 11-355 Telegraph Terminal CF-2-A (Carrier).
- TM 11-355B Telegraph Terminal CF-2-B (Carrier).
- TM 11-358 Telegraph Central Office Set and Switchboard BD-100 (being revised).
- TM 11-464 The Teletypewriter Operator.
- TM 11-486 Electrical Communication Systems Engineering.
- TM 11-487 Electrical Communication Systems Equipment.
- TM 11-624 Radio Set AN/MRC-2.
- TM 11-680 Fundamentals of Teletypewriter Circuits and Equipment (when published).
- TM 11-2001 Complete 100-mile Spiral-Four Carrier System.
- TM 11-2004 Repeater Set TC-18 (Terminal, Telegraph).
- TM 11-2005 Repeater Set TC-19 (Intermediate).
- TM 11-2009 Telegraph Terminal CF-6 (Carrier).

- TM 11-2022 Application of Packaged Equipment to Open-Wire Lines.
- TM 11-2200 Bias Meter I-97-A.
- TM 11-2203 Teletypewriter Set AN/TGC-1.
- TM 11-2206 Telegraph Terminal Set AN/TCC-1, Telegraph Terminal TH-1/TCC-1, and Filter F-2/GG.
- TM 11-2214 133A2 Teletypewriter Subscriber Set and Associated Equipment.
- TM 11-2215 Teletypewriters TT-5/FG and TT-6/FG.
- TM 11-2216 Teletypers TT-7/FG and TT-8/FG.

c. SHIPPING INSTRUCTIONS.

- U. S. Army Spec Army-Navy General Specifications for Packaging No. 100-14A and Packing for Oversea Shipment.

d. DECONTAMINATION.

- TM 3-220 Decontamination.

e. DEMOLITION.

- FM-5-25 Explosives and Demolitions.

f. CAMOUFLAGE.

- FM 5-20 Camouflage, Basic Principles.

g. OTHER TECHNICAL PUBLICATIONS.

- FM 21-8 Military Training Aids.
- FM 21-40 Defense Against Chemical Attack.
- TB SIG 13 Moistureproofing and Fungiproofing Signal Corps Equipment.
- TB-SIG 25 Preventive Maintenance of Power Cords.
- TB SIG 66 Winter Maintenance of Signal Equipment.
- TB SIG 69 Lubrication of Ground Signal Equipment.
- TB SIG 72 Tropical Maintenance of Ground Signal Equipment.
- TB SIG 75 Desert Maintenance of Ground Signal Equipment.
- TB SIG 171 Telegraph Adapter TH-4/U.
- TM 11-453 Shop Work.
- TM 1-455 Electrical Fundamentals.
- TM 11-456 Wire Telegraphy.
- TM 11-462 Signal Corps Reference Data.
- TM 38-650 Basic Maintenance Manual.

h. FORMS.

- WD AGO Form 468 Unsatisfactory Equipment Report.
- AAF Form 54 Unsatisfactory Report.

2. Abbreviations

- ac alternating current (n)
- a-c alternating-current (a)
- CAR RET Carriage return
- CH channel
- contd continued
- cu ft cubic foot (feet)

db	decibel (s)
dc	direct current (n)
d-c	direct-current (a)
diam	diameter
F	Fahrenheit
fig.	figure
FIGS	figures (position)
ft	foot (feet)
ga	gauge
in.	inch (es)
lb	pound (s)
LTRS	letters
ma	milliampere
mf	microfarad
opm	operations per minute
par.	paragraph
rpm	revolutions per minute
subpar.	subparagraph
w	watt
wpm	words per minute

3. Glossary of Terms Used in Teletypewriter Maintenance

The following glossary contains explanations of technical terms used in this manual.

Adapter. An accessory used to change or alter an electrical plug, or the like, so as to render it suitable for a new mounting.

Bias. Line bias: the effect on the length of telegraph signals produced by the electrical characteristics of the line and equipment. If the received signal is longer than that sent, the distortion is called *marking bias*; if the received signal is shorter, it is called *spacing bias*.

Bias, applied. A force (electrical, mechanical, or magnetic) exerted on a relay or other device which tends to hold the device in a given electrical or mechanical condition.

Bias distortion. The distortion produced by bias.

Bias meter. A meter for measuring the amount of marking or spacing bias that may be present in a transmitted signal.

Break contact. That contact of a switching device which opens a circuit upon the operation of the device.

Break key. On a teletypewriter, the key used to break into the transmission being received from another station.

Capacitance. The ability or capacity to receive an electrical charge.

Capacitor. A device for inserting the property of capacitance into a circuit; two or more conductors separated by a dielectric.

Carrier current. A current upon which is impressed a current of another frequency to transmit intelligence.

- Carrier frequency.* The frequency of the carrier current.
- Centrifugal.* Proceeding or flying away from the center.
- Centrifugal force.* A force which impels a body, or parts of a body, outward from the center of rotation.
- Characteristic.* A distinguishing trait, quality, or property.
- Closed-circuit system.* A telegraph system in which, when no station is transmitting, the circuit is closed and current is flowing in the circuit.
- Cycle.* In a periodic phenomena, one complete set of recurring events.
- Decibel.* A unit of transmission expressing a relation between input and output power.
- Differential.* Pertaining to, or involving, a difference; that is, a differential current device is one which operates upon the basis of a difference in two current values.
- Distortion.* An alteration or a deformity of a waveform.
- Duplex.* Operation in two directions simultaneously over one circuit.
- Filter.* A device for preventing the passage of current of certain frequencies while allowing currents of other frequencies to pass.
- Frequency.* In periodic phenomena the number of vibrations or cycles in unit time; in alternating current the number of cycles per second.
- Function.* The duty or job performed by a device. With regard to teletypewriters, the mechanical operation of line feed, carriage return, space, letters shift, figures shift, unshift on space, and motor stop.
- Fuse.* A wire, bar, or strip of fusible metal inserted as a safety device in an electric circuit. When the current increases beyond the rated strength of the fuse, the metal melts and thus interrupts the circuit.
- Fusetron.* A fuse equipped with an overload feature. A fusetron will take a starting load up to 50 percent in excess of its rated value for a short period of time before blowing. Has a base connection similar to a fuse.
- Fustat.* A fuse equipped with an overload feature the same as a fusetron, but having a different base connection. Must be used with an adapter for insertion into a fuse socket.
- Gear.* A set of appliances as of cog wheels, serving to transmit motion or change its rate or direction.
- Governor.* An automatic attachment to a motor for controlling the speed of rotation.
- Ground.* The contact of a conductor with the earth; also the earth when employed as a return conductor.
- Grouping circuits.* Circuits used to connect two or more switchboard positions together so that one operator may handle the operation of those positions from his own operator's set.
- Insulator.* A nonconducting substance or body.
- Jack.* In combination with a plug, a device by which connections can readily be made in electrical circuits.

- Key.* A hand-operated device for the rapid opening and closing of a circuit or circuits.
- Keyboard perforator.* A mechanism consisting of a keyboard and a perforator, by which means a tape is perforated in accordance with a code corresponding to the depressed character key of the keyboard.
- Latch.* To secure or fasten as with a catch.
- Leakage.* Current loss through imperfect insulation.
- Lever.* A mechanical device; a beam pivoted on a fixed point or fulcrum, serving to impart pressure or motion to exert effective power.
- Lockwasher.* An open, spiral, spring tempered steel washer for preventing the loosening of nuts.
- Loop.* Subscriber's loop: The pair of conductors connecting a subscriber's instruments with the main frame of the central office. Loop mile: the resistance of a pair of conductors between two points one mile distant; the resistance of the two conductors connected in series.
- Make contact.* That contact of a device which closes a circuit upon the operation of the device.
- Marking bias.* That bias which affects the results in the same direction as marking current.
- Marking contact.* That contact of a telegraph relay which is closed when marking current is controlling the relay operation.
- Marking current.* That magnitude and polarity of current in the line when the receiving mechanism is in the operated position.
- Microfarad.* Practical unit of capacitance; one-millionth of a farad.
- Milliampere.* Unit of electric current; equal to one-thousandth of an ampere. Usually referred to as ma.
- Ohmmeter.* A direct reading instrument for measuring resistance, calibrated in ohms.
- Opn.* Operations per minute.
- Patching.* Temporarily connecting together two lines or circuits by means other than switchboard cord circuits.
- Patching cord.* A cord terminated on each end with a plug, used in patching between circuits terminated in jacks.
- Period.* The time required for the completion of one cycle.
- Platen.* The part of a typewriter or teletypewriter on which the paper is supported to receive the impression.
- Plug.* In combination with a jack, a device by which connections can readily be made in electrical circuits.
- Polar.* A system of telegraphy in which the current in the line is reversed in polarity in changing from marking to spacing.
- Polarential.* A telegraph transmission system in which transmission in one direction is polar with equal and opposite transmitting voltages for marking and spacing, and transmission in the other direction is differential with voltage applied for the spacing condition and ground for the marking condition.

Polarized plug. A plug that is so constructed that it can be inserted into an outlet in only one way.

Pulsating current. Current of varying magnitude but constant direction.

Range. The upper and lower limits through which the index arm of the range-finder mechanism of a teletypewriter may be moved and still receive correct copy.

Rectifier. A device for changing alternating current to pulsating direct current.

Repeater. A device for the retransmission of a signal, usually with amplification.

Repeating coil. An audio-frequency transformer for transferring energy from one electrical circuit to another, usually one-to-one ratio with one side (line connection) arranged so that a center tap may be obtained for simplexing.

Reperforator. A device for receiving teletypewriter signals as electrical impulses from a line and converting them into perforations in a tape.

Retardation coil. A coil offering high impedance to voice-frequency currents but low impedance to direct current.

Rheostat. A variable resistance for limiting the current in a circuit.

Simplex. A method of obtaining an additional telegraph channel by the use of repeating coils.

Spacing contact. That contact of a telegraph relay which is closed when a spacing impulse is controlling the relay operation.

Spacing impulse. That period of time in which the circuit polarity of current is reversed or, in a neutral system, when the signal line is opened, the receiving mechanism is caused to be in the unoperated or released position.

Switch. A device for opening, closing, or rerouting an electrical circuit.

Switchboard. A board containing apparatus for controlling or connecting electrical circuits.

Synchronism. The state of being synchronous.

Synchronous. Having the same period and phase; happening at the same time.

Teletypewriter. An electromechanical device for the transmission of characters as electrical impulses, and the reception and printing of characters to correspond with the impulses received.

Teletypewriter code. A special code in which each code group is made up of five units or elements of equal length. These units or elements are known as marking or spacing impulses.

Terminal. One end of an electrical circuit.

Transmitter distributor. A distributor consisting of a rotating arm with brushes in contact with conducting segments of a circle; used in the transmission of teletypewriter signals.

Trunks. A circuit between two switchboards, central offices, switchboard positions, or other parts of a wire plant, but not to any subscriber.

TWX. A trunk between teletypewriter central offices. In the Army, TWX usually refers to trunks from Army teletypewriter switchboards to commercial switchboards; or a message that has been transmitted through a commercial teletypewriter exchange.

Voice frequencies. Those frequencies covered by the range of human voice (usually below 3,000 cycles per second).

Zero bias. When the received signal is equal to the transmitted signal (neither longer nor shorter), the circuit is said to have zero bias.

APPENDIX III

MAINTENANCE PARTS

The following information on War Department Signal Supply Catalog pamphlets was compiled on 10 December 1946. The appropriate pamphlets of the War Department Signal Supply Catalog for Reperforator Teletypewriter Sets TC-16 and TC-17 are:

Higher Echelon Spare Parts:

SIG 8-RA-87

Organizational and Higher Echelon Spare Parts:

SIG 7 & 8-BE-77 and BE-77-A and -B

SIG 7 & 8-TC-16

SIG 7 & 8-TG-26-A (when published)

For an index of available catalog pamphlets, see the latest issue of War Department Signal Supply Catalog SIG 1 & 2.

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